NOVEMBER 1958

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ILLUMINATING ENGINEERING

Journal of the
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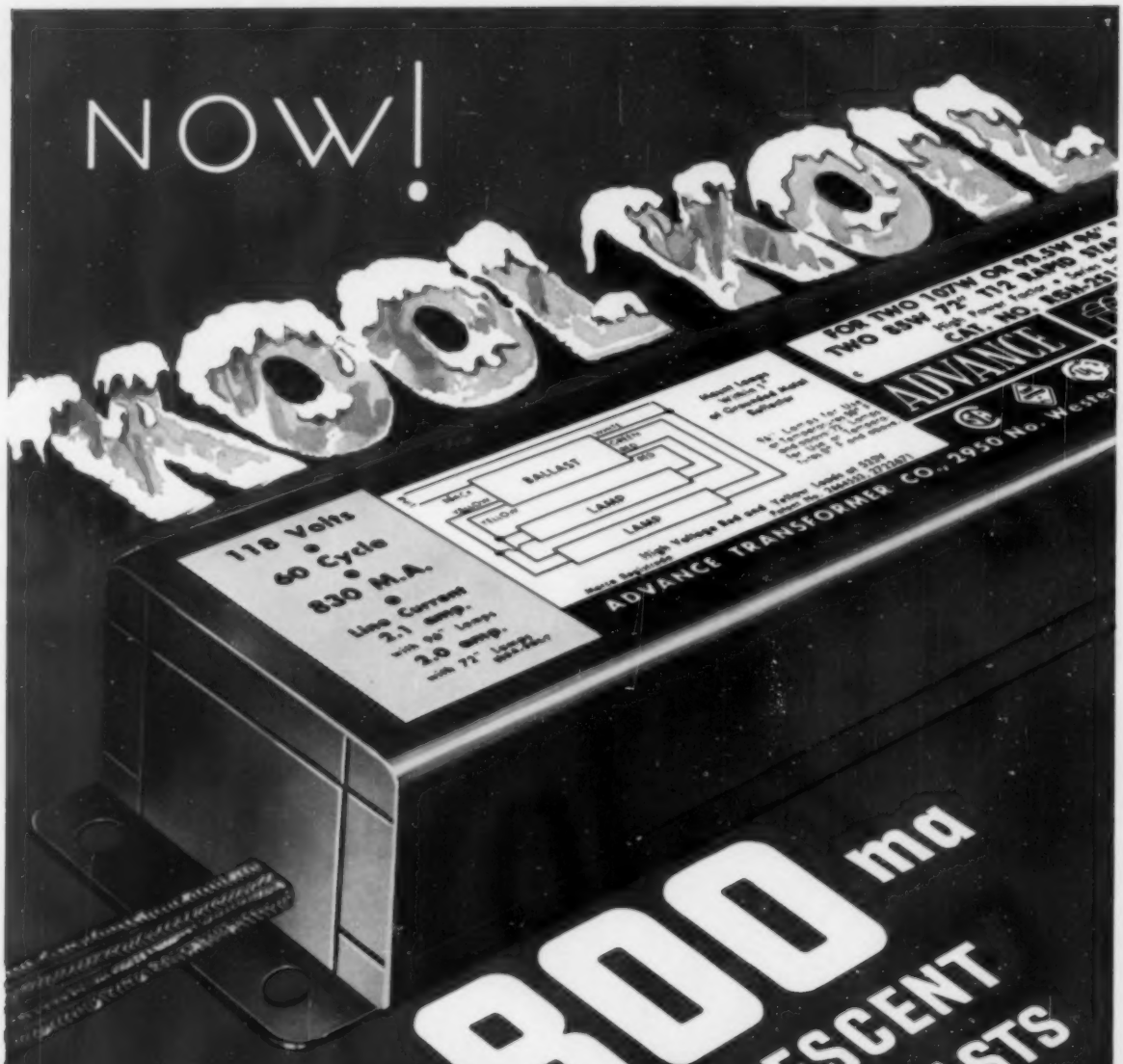

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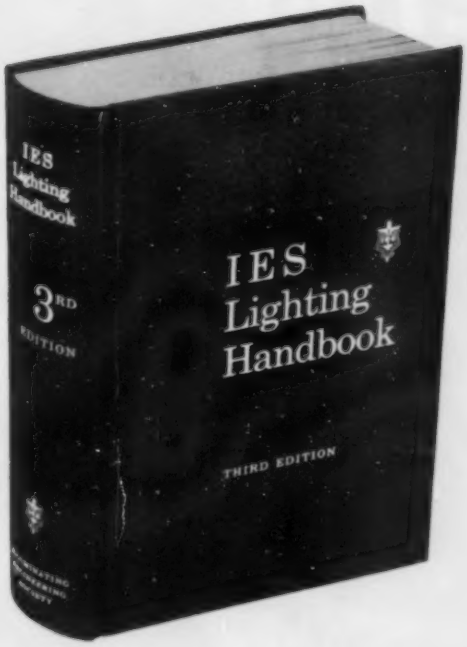

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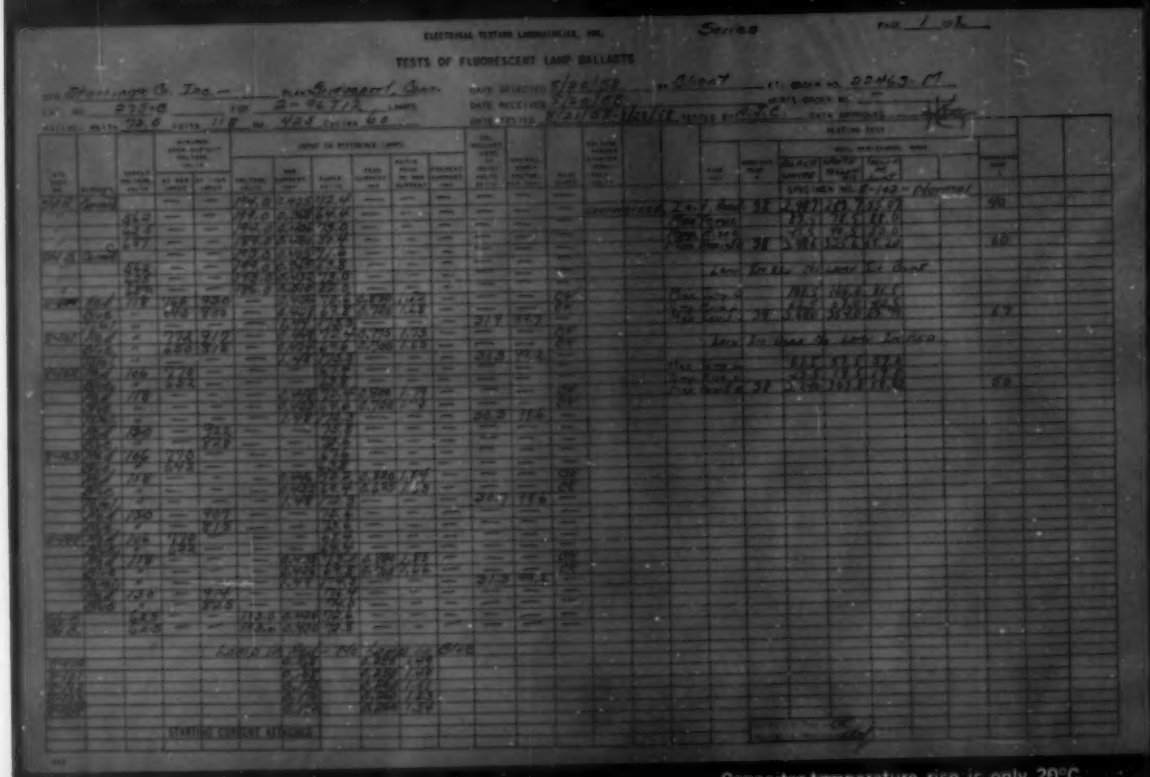

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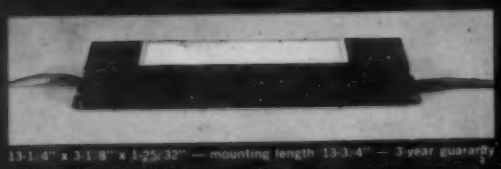

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November 1958

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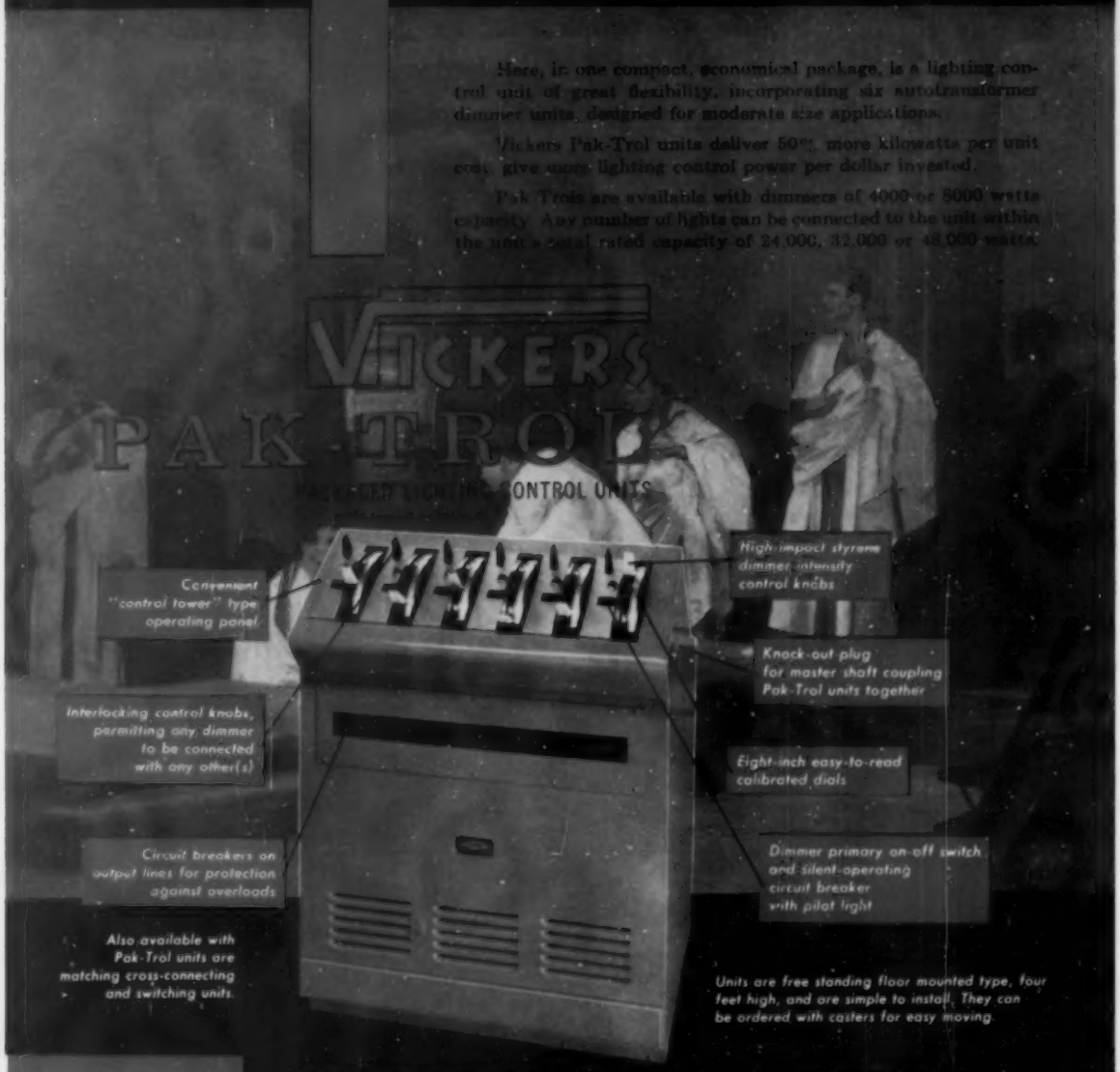
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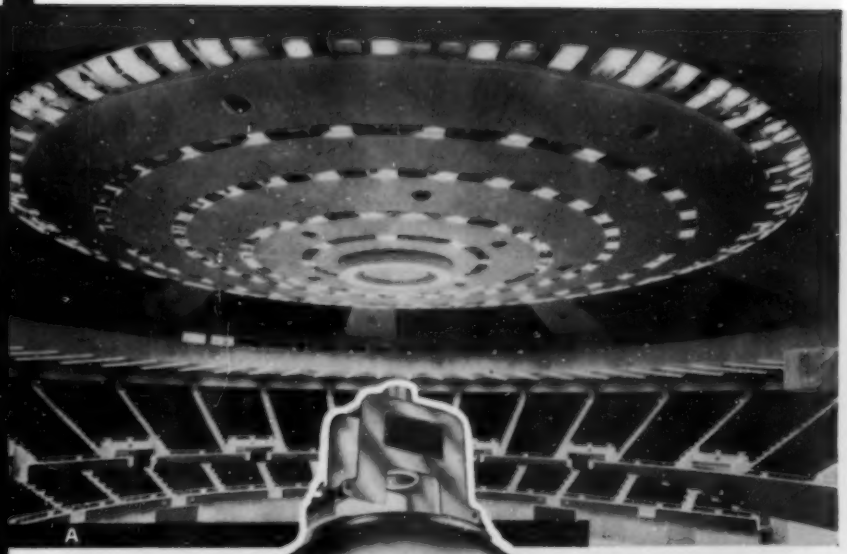

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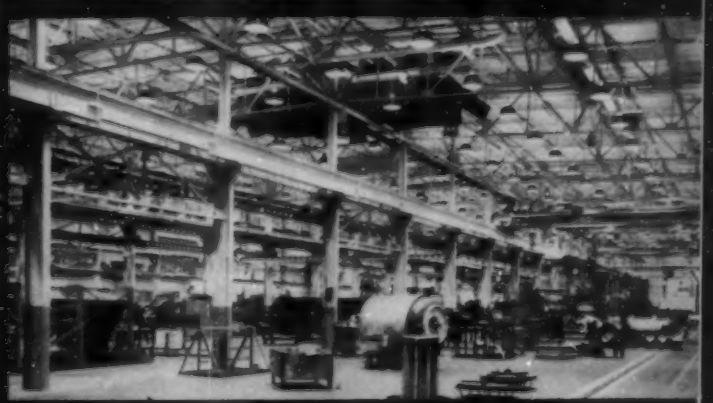

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CONSULTING ELECTRICAL ENGINEER: Lionel G. Gale, Boston, Mass.
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FIRST PRIZE
CLASS II

HOUSE OF SEAGRAM

Ezra Stoller

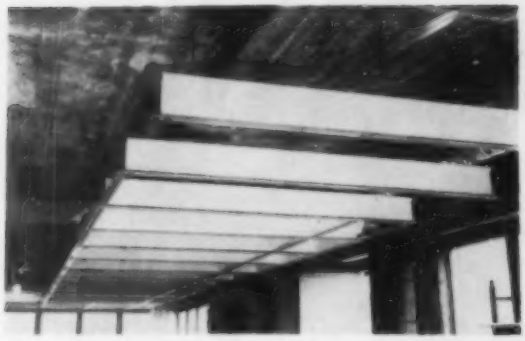
IT CAN'T be coincidence every time that the "year's most heralded building" also turns up as the top lighting job in the MMILJ contest. Perhaps the excellence of the lighting contributes its share to the kudos the building receives in the architectural press. In any case, once again the national winner of My Most Interesting Lighting Job contest is a greatly praised new building—this time on New York's skyline.

Noel S. Florence
New York Section
Northeastern Region

Mr. Florence is Chief Designer for the Architectural Division of Lightolier Inc., Jersey City, N. J.

There are several interesting lighting innovations included in the design of Seagram's. The particular problem (and its solution) covered by Mr. Florence's contest entry, dealt with the design of a perimeter luminous ceiling to match the Mies van der Rohe architectural concept as embodied in this bronze skyscraper. The luminous element forms a continuous band around the building's glass-walled perimeter for daytime office lighting, and for nighttime drama. Broad specifications for the system evolved as:

- A ceiling grid on 55½- by 55½-inch centers to line up with the building module with provision for half module spaces where required.
- Grid members of anodized brushed aluminum 3½ inches wide to suit wall partitions which would be anchored to it.
- Uninterrupted span of diffuser within the grid. In other words, 52 by 52 diffusers with no auxiliary support gridwork.
- Maximum plenum depth of 12 inches.
- Provision for ducts and beams to cross through the 12-inch plenum without casting any shadows on the diffusers.
- Sound barrier within the plenum to prevent sound from passing through the ceiling from one private office to another.



1. "I" beams 12 feet long form the "sides" of the fixture cell. These were installed first from previously set hanger rods.

2. One side and end being positioned (man at left); at right, a cross channel housing going up. Notice sloping sides for a beam intrusion.

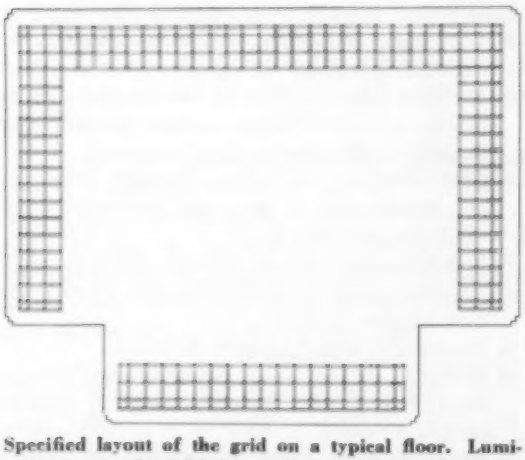
- Maintained lighting level of 85 footcandles with warm white deluxe lamps. Separate lamps and circuits to give about 20 footcandles maintained with warm white deluxe lamps. This separate circuit to be used every night after office hours for a tower of light effect.

Solution

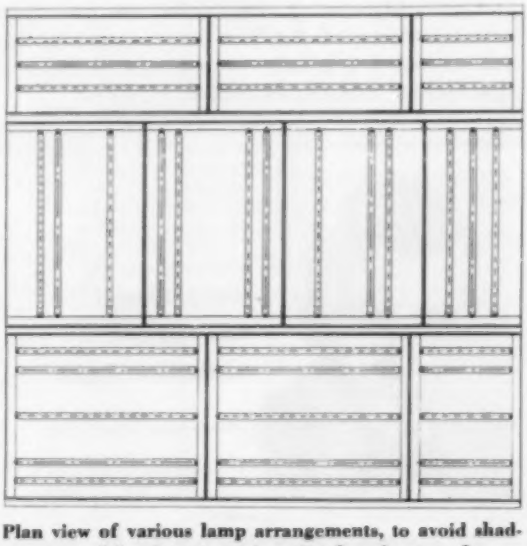
There is a repetitive element one module wide and two and a half long. It was decided to enclose this element to give a cavity (or box) about 12 feet long, 4½ feet wide and one foot deep. This provides the required sound barrier and a very efficient plenum with an excellent maintenance factor. In addition it permits control of shadow-making beam and duct intrusions in the plenum.

Since a box 4½ feet wide and 12 feet long would be almost impossible to handle, it was designed in sections, namely: sides, ends and tops. The sides are 12 feet long formed into "I" beam sections, suspended by hanger rods with locking leveling nuts. End plates attached to the 12-foot sides close off the box. The top of the box is provided by four shallow pan fixtures with combined ballast channel and socket bracket. This arrangement repeated thousands of times provided the enclosed lighting plenum.

The ceiling grid itself comprises a steel rolling with snap-on anodized aluminum trim. The diffuser is 54- by 54-inch 15-mil rigid vinyl stretched in a frame recessed inside the grid trim so that the



Specified layout of the grid on a typical floor. Luminous area is about 12 feet wide and 320 feet long and forms a luminous "band" around the perimeter of the glass-faced building.



Plan view of various lamp arrangements, to avoid shadows caused by duct intrusions in the plenum. Lamps shown with long and short interrupted lines are run at 120 ma fed by the separate night circuits.

3. Fixture pan forms top of the box. Each pan is fitted with retractable brackets which slide out and hook over the "I" beam.

4. Connecting night circuit on one side and day circuit on the other. Note that the ballast channels form a continuous wireway.

frame itself is completely concealed. Only the grid and the diffuser itself are seen from below, with no hint of a frame within a frame. The completely flat untextured diffuser matches the Mies van der Rohe architectural concept.

Each X member of the grid is mounted in a housing with a negative acting spring device to hold it in place; the X member may be pulled down to remove diffusers for washing. For relamping, diffusers slide one over the other. This housing is also the all-important lateral spacing member which ensures accuracy over 100-foot runs. Where a duct or beam intrudes into the 12-inch plenum, the standard 12-foot member is replaced by one with a cavity formed by sloping slides, which envelops the intrusion. Lamps are arranged in this case to eliminate shadows. The standard arrangement uses 40-watt 425 ma lamps on 16-inch centers. One non-standard arrangement copes with the problem of duct intrusions; the other is used for half-module spaces. Some 20-watt lamps are used on both non-standard alternates. The lamps shown with a long and short interrupted line are run at 120 ma fed by the separate night circuits.

The completed system very successfully meets its objectives both for its functional use as an office, and its nighttime display as a corporation symbol. With a brightness for the luminous ceiling of 190 footlamberts, 57 for the walls, and 18 for the floor, brightness ratios are well within comfortable ranges. Close brightness ratios also obtain between the ceiling and the outdoors, an important consideration with the totally glass window walls. Tinted glass has been used for this wall, giving a 50 per cent transmission of light. After working hours, when the nighttime circuit takes over, the building is seen as a tower of light, visible for miles around.

5. Completed plenum. Anodized aluminum trim snaps on. Both circuits are on in this picture; dim lamps on the night circuit.

6. Diffuser panel of vinyl plastic installed on ceiling grid members. For re-lamping, panels slide over into an adjacent module.

FIRST PRIZE
CLASS I

"Enlarging"

Entry, with decorative fixtures.

Lighted planter and aquarium in living room.

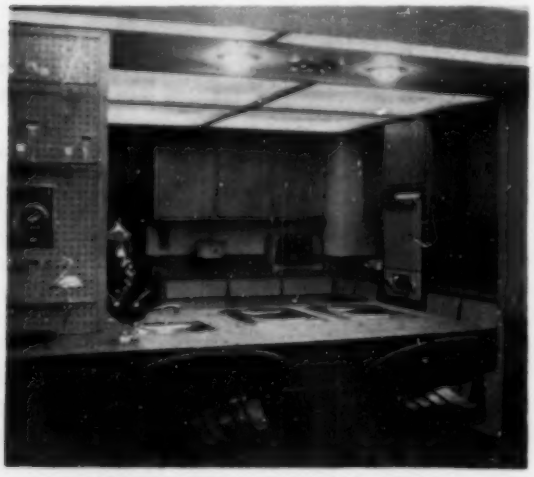
UNCONVENTIONAL building construction plus a thought-out lighting plan can do much to make a small house look larger. In lighting this demonstration home, Miss Borelli worked with architect R. Duane Conner and builder James Reedy, Jr., to achieve this end. Only 48 feet square, the house contains a living room, family room and den, three bedrooms, two baths and, of course, a kitchen.

Several factors — orientation, architecture and lighting — combine to produce a feeling of greater size and expanse, for both exterior and interior.

Orientation. Placement of the building diagonally on the lot adds approximately 20 feet to its apparent dimensions as seen from the street. This arrangement also camouflages the narrowness of the side, gives variation to the "peas-in-a-pod" appearance so common in tract housing, and provides four areas for outdoor living instead of the usual front and back yards.

Architecture. The finished ceiling of the building is fastened to the inside of the roof framing, rising from the eaves to a central utility core. This core, containing the kitchen and space for mechani-

Family room, also with decorative fixtures.



Kitchen, in center core, and snack bar.

Marguerite Borelli
Central Oklahoma Chapter
Southwestern Region

a Small Home

Miss Borelli is Supervisor of Home Planning with the Oklahoma Gas and Electric Co., Oklahoma City, Okla.

cal equipment above, is the only opaque interior structural element that rises to the complete ceiling height. Other partitions extend only to a seven-foot height, with glass filling in the triangles above. All rooms around the perimeter of the house are, thus, visually under the same ceiling, giving a continuous flow of space. Exterior walls are eight feet high and those at the center core are twelve feet high.

Lighting. Supplementing the architectural theme of one room "flowing" into another, general lighting is from continuous valances and coves around the entire perimeter of the interior. Sections of the valances are individually switched for variety in lighting level. Portable equipment supplies supplementary lighting at strategic spots.

In addition to general lighting in the living areas, decorative fixtures are used at the entry and over the table in the family room. A lighted tropical fish aquarium adds interest to the living room. Also in the living room, at the center core wall, the valance, here equipped with plastic diffuser, gives downlight for a large planter and uplight to dramatize the twelve-foot ceiling height.

In the working area of the kitchen, which is in the center of the home, a luminous ceiling of Plexiglas is lighted by three 8-foot rows of lamps mounted 18 inches above the plastic panels. Two 60-watt semi-recessed incandescent units light a snack-bar between the kitchen and the family room. This build-up of lighting provides a screen of light to separate the kitchen from the family area when the luminous ceiling is not in use.

The front of the house is lighted by five semi-recessed 100-watt incandescent fixtures at the garage entrance, front door and along the walls. The patio, off the family room, is made useful at night by two semi-recessed units in the roof overhang in front of the sliding glass doors. The barbecue pit is lighted by two permanently mounted bullets installed in the overhead lattice work.

Exterior, with incandescent lighting.

Patio and barbecue pit.

Quality Lighting

Elizabeth A. Meehan
Philadelphia Section
East Central Region

Miss Meehan is Residential Lighting Specialist with Philadelphia Electric Co., Philadelphia, Pa.

EARLY last year, a home lighting program, directed at speculative builders, was inaugurated in Philadelphia, providing a challenge to create quality lighting designs for 57 sample homes completely divergent in cost and character. Miss Elizabeth Meehan took on the challenge, thereby finding her "Most Interesting Lighting Job" of the year. The program proved gratifying in that the 20 sample homes opened during the year had lighting installed, at the builder's own expense, in accordance with IES recommended practice. In recogni-

Family Room, Class II split level home. A 12-foot cornice at the window area, using three 40-watt T12 deluxe warm white lamps, and a center ceiling fixture, with three 60-watt inside-frosted incandescent lamps, supply 30 footcandles general lighting. This is supplemented by the use of portables. A double bullet with 75-watt R30 flood accents the fireplace.

Family Room, Class III traditional ranch style house. Six louvered downlights are arranged in an oval pattern (5 by 6½ feet) in the center of the room, with 100-watt pink, yellow and blue lamps. A bullet unit, using 150-watt R40 spot lamp accents the fireplace. Two pendent lights with 100-A inside frosted lamps, planned for a bar which was taken out, related well to the buyer's furnishings, so they remained. At the opposite end of the room, not shown, three downlights with 150-watt R40 floods dramatically illuminate the draperies in a bow window. Fixed lighting alone in this room provides 55 to 60 footcandles.

in Sample Homes

tion of the economic limitations imposed on the speculative builder, the lighting specifications were in three price ranges, differing in quality of luminaires and the extent of special or decorative lighting. Homes selling for under $15,000 are Class I homes; those from $15,000 to $30,000 Class II; and those over $30,000 Class III. Two of the installations shown here are in Class I homes, and three in Class II and Class III. Architectural style range is from authentic colonial to ranch houses and contemporary split level.

Dining Area, Class I house. Valance lighting has a ready acceptance by the builder because of the ease of installation and the built-in custom appearance it gives to a development house. This valance, using two 40-watt T12 lamps in conjunction with the pulley fixture, which has 150-watt incandescent lamps, supplies 55 to 60 footcandles in the 10- by 11-foot area.

SECOND PRIZE CLASS I

Bathroom, Class III house. Three 14- by 50-inch troffers, each equipped with two 40-watt T12 warm white deluxe lamps, light this 8-foot-square bathroom. The troffer over the lavatory has been built into a 22-inch wide soffit dropped 12 inches from the ceiling to supply higher levels on the face. Vinyl plastic with a decorative star pattern is used as the shielding medium. About 40 footcandles are provided on the vertical planes of the face and there are about 170 footcandles horizontal.

Bathroom, Class II home. Canopy overhang has buyer appeal, because it adds a custom quality to a speculatively built house. Photo below shows one of 10 such installations. Here the built-in luminaire, using two 40-watt T12 lamps, and a 60-watt vapor proof unit in the enclosed shower provide about 130 footcandles in this 5- by 7-foot bathroom, and 35 to 40 footcandles on the vertical surfaces of the face.

Quality Lighting In Sample Homes

Bedroom, Class I home. Valance bracket, photo at right, lamped with two 25-watt T12 lamps supplies local lighting for reading in bed, as well as soft indirect general illumination. All built-in installations are based on IES Recommended Practice design details.

Bedroom, Class II traditional house. Here a valance, using three 40-watt T12 lamps supplies general illumination, supplemented by table lamps. In all bedrooms, except for those having valance lighting, a minimum of a four-socket 17-inch diameter ceiling fixture is used for general illumination.

Kitchen, Class III home. The preassembled luminous ceiling shown here is one of five such installations in bathrooms and kitchens. This 4- by 6-foot luminaire is equipped with six 75-watt inside frosted lamps and supplies about 40 footcandles general illumination. Over the sink, 35 footcandles are provided by a 40-watt T12 lamp, 45 to 50 footcandles over the range by two 60-watt incandescent lamps and about 35 footcandles at the work area from a 20-watt T12 fluorescent lamp. General illumination in the 10- by 14-foot kitchen is about 100 footcandles.

Lighting an Inside

Stained Glass Window

m·i·l·j

SECOND PRIZE
CLASS II

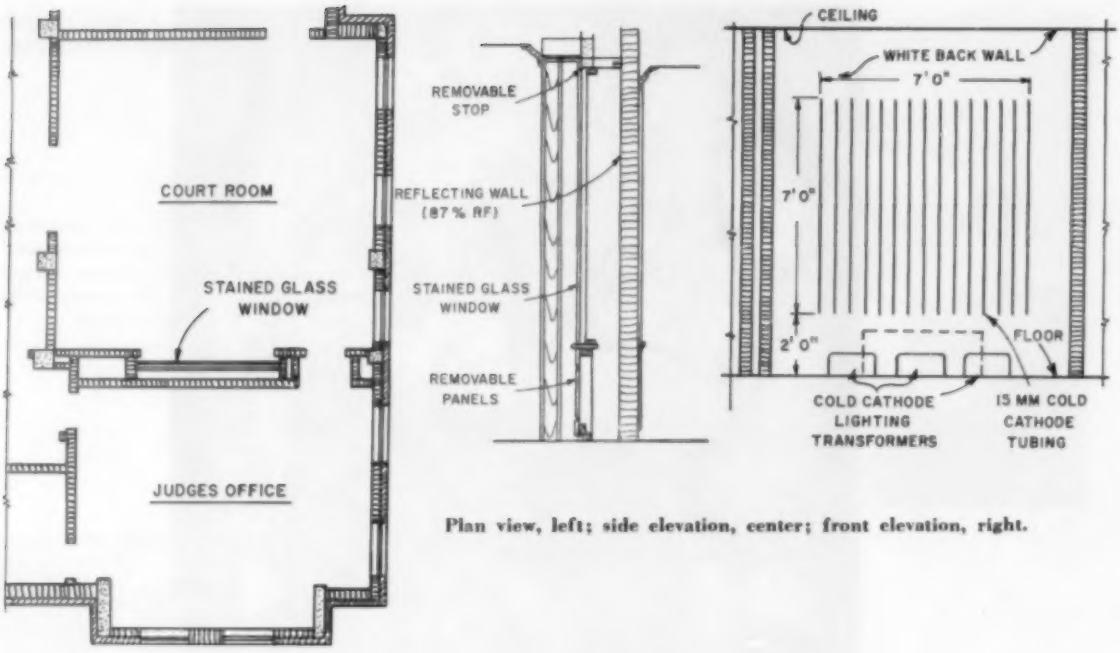
James F. Fletcher
Mid-South Chapter
South Central Region

Mr. Fletcher is with Standard Electric Co., Contractors and Engineers, Memphis, Tenn. At the time of this installation, he was affiliated with Flinn, Fletcher, Humphrey, Inc., of Memphis.

INGENUITY of solution and interest in a lighting job are not confined to vast installations, as devotees of the MMILJ contest well know. Mr. Fletcher's most interesting job, for example, is one single item of a large new building extension — a stained glass window in an inside wall.

History of the window is itself rather interesting. The window, and two iron dogs, were once well-loved items of an old residence which occupied the site of the Juvenile Court Building in Memphis, Tennessee. The residential property had been willed to the city for use by the Juvenile Department *provided* the stained glass window would be part of any building structure on the property, and that it be in constant use. Further, the two iron dogs must remain on the courthouse lawn in full public view.

The old Juvenile Court Building had used the window, as stipulated. It presented no problem, since daylight streamed through it, to the desk of the Court Room's presiding judge, who sat with her back to it. When the new addition to the building was planned, with a new Court Room, the



Plan view, left; side elevation, center; front elevation, right.

judge had a stipulation too. The stained glass window must be used in exactly the same position in relation to her desk as in the old building.

This stipulation *did* have problems. The window would now be on an *inside* wall, and to have the same appearance would have to be artificially lighted. Further, the space available behind it was practically infinitesimal. Actually it was a total of 11 inches, from the back of the glass to the reflecting wall. For its artificial lighting in this tiny space, an additional problem was that some sections of the glass were not stained but transparent. The 100-year-old window could not, the glass people said, withstand sandblasting to conceal light sources behind the clear glass sections. As a solution to this problem, Mr. Fletcher covered the entire back of the window with a diffusing vinyl plastic sheet.

The entire space behind the window was painted to an 87 per cent reflectance white to provide as luminous a panel as possible. Low brightness sources were required if the colored sections of the glass, now faded, would not be washed out. Very long life sources were also needed since the only access to the light sources would be by removing the window altogether.

Within the shallow cavity, 15 rows of cold cathode tubing were installed in the 7- by 7-foot area, on 6-inch centers. The tubing selected was 15 millimeter, 60 milliampere, standard warm white. The portion of the tubes nearest the back of the glass was painted with white lacquer in order to reduce the surface brightness. This assured that the entire reflecting panel of wall *and* tubes would be as near the same surface brightness as possible. This feature of the solution, painting the forward side of the tubes with white lacquer, was one of the most important factors in the job's success. The painting had to be accomplished on the job, after the tubes had been installed, and with the tubes lighted. The tubes were tested for lamp life, and are estimated to last between 15 and 20 years.

Transformers for the tubes were installed in the space below the window and on the floor, mounted on rubber shock absorbers to reduce the noise level. Removable panels were installed in the wall for access to them.

Final results of this interesting job are also very gratifying. The colors remain true, and all of the transparent sections, which are now more pronounced, have the appearance of obscure glass. The window is a perfect luminous panel through which electric light now streams, its source quite invisible, its distribution perfectly even.

THIRD PRIZE
CLASS II

HOME DECOR AND A

Banking Area

AN UNUSUAL (and most interesting) lighting problem developed here, for an area which usually is fairly routine. The interior designer planned an early American home-like environment for the bank, a small branch office of Home Building and Savings Company located in a new suburban shopping center near Toledo. The decor included fully carpeted floors, mirrors, murals, draperies, chintz-covered maple furniture, and residential-type portable lamps. Soft music played throughout the working day.

To tie in a commercial lighting system, and the high levels needed for banking, with a residential atmosphere was one of the lighting problems posed. Another was the shape and size of the space. The room was 19 feet wide and 120 feet long. Fixtures provided by the builders were to consist of two rows of 96-inch bare lamp channels.

Obviously this was not harmonious with the decorator's "home building" motif. Mr. Crookes' "most interesting job" was its transformation to a lighting system more compatible with this, and at the same time one affording more comfortable seeing conditions. The bank's remodeled main office had won first prize in the Northwestern Ohio Chapter's MMILJ contest three years ago. Mr. Crookes' design for their branch office was in consequence received with respect for what lighting could do for an interior; his layout faithfully followed.

The area over the tellers' section was dropped down 30 inches with an acrylic plastic luminous ceiling equipped with acoustic baffles. This section was just wide enough to allow single 96-inch bare lamp fluorescent channels to be mounted on the

Clifford Crookes

Northwestern Ohio Section

Great Lakes Region

Mr. Crookes is Commercial Lighting Representative with Toledo Edison Co., Toledo, Ohio.

ceiling on 24-inch centers. This entire area was framed in with a maple finished plywood facing, with metal inserts for ventilation of the plenum. To supplement this ventilation, three small sections of plastic grate-type louvers were inserted into cut-out sections of the acrylic diffuser. These openings allow for air circulation under the ceiling, counteracting stagnant air pockets.

Over the customers' section, an acoustic tile ceiling was specified, 18 inches higher than the tellers' ceiling, in which were installed two-lamp 48-inch troffers with curved prismatic glass lens, on 6-foot centers. Two square incandescent filament recessed units over the customers' desks give extra punch at these spots, and are also used as night lights.

Three private offices in the rear are equipped with partial luminous ceilings with corrugated vinyl plastic on T-bars using 96-inch fluorescent lamps on 15-inch centers. There are 110 foot-candles on desk tops in these rooms.

Two important decorative features of this banking room are the full length mirrors on the wall, which reflect the entire lighting treatment. A visual effect of a much larger area is created. In the tellers' section, where the level is 78 foot-candles, the mural adds still further to an illusion of looking off into the outdoors.

The home building theme desired by the decorator has been very successfully retained in this installation; aesthetics and good practical seeing levels combined for a most interesting interior.

Modern Living From Modern Lighting

An opportunity to design for a truly gracious modern home, with full owner-architect cooperation, is one of a lighting designer's rosiest dreams. Mr. Schroeder's entry represented just such an opportunity — a chance to use lighting as a subtle art for the enhancement of a home whose first objective was gracious living, and as an important element of the home's modern facilities.

George C. Schroeder, Jr.
New Orleans Section
South Central Region

Mr. Schroeder is with Schroeder and Associates, Consulting Engineers, New Orleans, La.

The home is located in modern New Orelans, on the shores of Lake Pontchartrain, only a few minutes drive from the old-world charm of the Vieux Carre. Its owners, Mr. and Mrs. Louis J. Roussel, and its architects, August Perez and Associates, wished particularly to exemplify the charm for which New Orleans is noted, in a home which would at the same time incorporate all the facilities required for modern living. Lighting design, with its control, was a major factor in producing such an environment.

Unusual (and useful) lighting techniques start at the very edge of the garden; in fact, the exterior lighting effects are an important part of the structure's nighttime charm. Entrance to the house is highlighted by high-level downlighting from vapor-tight units recessed in the canopy, with 150-watt incandescent. The foyer is lighted by a suspended 18-inch diameter low-brightness sphere constructed of natural shell and pewter leading, together with indirect lighting from two 40-watt fluorescent lamps concealed above the guest coat closet. Fluo-

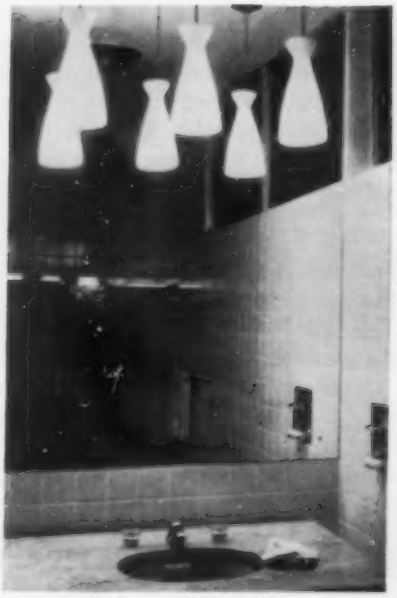
Entrance.

Kitchen.

THIRD PRIZE
CLASS I

Fireplace end of game room.

Dining room, from patio.



Bath.

rescent lamps are T-12 40-watt rapid-start or T-12 20-watt deluxe warm white.

Controlled daylighting obtained from roof-mounted diffusing Plexiglas skydomes illuminates the corridor by day. To obtain the same effect by night, four 20-watt fluorescent lamps have been built into the roof structure under the skydome. A concave Plexiglas dome diffuser shields the lamps from view below. These lighted domes, besides providing adequate lighting of the corridor, add interest to the exterior appearance at night.

Center of activity in the home is the glass-walled play room overlooking the exterior patio and swimming pool areas. Multiplicity of switching combined with auto-transformer dimming is used here, to produce lighting effects for setting the mood for any occasion. General lighting is provided by deep semi-recessed baffled, 150-watt R40 incandescent units closely spaced along the inside wall of the room. This wall, consisting of sliding paneled fiber glass doors, serves to conceal a bar, when this is not in use, and to act as a divider to close off the dining area. The game table at the far end of the room has a shielded adjustable incandescent unit located directly over it, while on the other end of the room the fireplace is highlighted by means of two recessed adjustable 150-watt R40 spot lamps. Draperies selected for this room are of translucent fiber glass, readily conductive to transmission and diffusion of light. At the same time they provide privacy when the room is fully lighted. The draperies have been made to "glow" by using symmetrically spaced, wide distribution type, recessed incandescent units along the outside of the playroom's glass wall.

The rear patio and swimming pool area adjacent to this room has been lighted to especially enhance the "gracious living" aspects of the home. A combination of incandescent and mercury vapor lamps increases the nighttime beauty of the foliage. Low incandescent terrace lights are placed in a random manner through the area, while 100-watt mercury vapor lamps, concealed from view, are used to accentuate the planting along the rear wall. The swimming pool has underwater lighting fixtures.

Atmosphere was also the key to the design of the dining room. Here a specially designed three-lamp suspended incandescent fixture provides direct lighting for the dining room table. Each lamp is shielded from view by a diffusing plastic disk. Subdued general diffused lighting is produced from the high reflectance floor, ceiling and furnishings. This is supplemented by reflected light from the glass walled patio.

In the kitchen area, the main lighting for food preparation is from a built-in trough recessed in the furred ceiling area in front of the cabinets. Additional illumination is provided by a built-in fluorescent lighting unit under the cabinets. For the dishwashing area, high levels are supplied by a deep recessed fixture having a partial parabolic anodized aluminum reflector, using a 150-watt R40 floodlamp. Finally in this area, two 40-watt fluorescent lamps are concealed above the top of the suspended dividing cabinet, flooding the ceiling with light and bringing brightness ratios within recommended limits.

In line with the taste and desires of the owner, the master bedroom has been lighted with five carefully selected portable lamps. These lamps, located at the bed, desk and dresser, are all remotely controlled from switches at the door and bed locations. In the dressing room adjoining the master bedroom, 70 footcandles of uniform illumination is provided by a luminous ceiling of louvered plastic. Lamps are 40-watt fluorescent spaced 23 inches on center, within the 15-inch cavity. Also installed above the diffusing medium is a 15-watt incandescent lamp for use as a night light.

Bathrooms are lighted to 120 footcandles, by a combination of central recessed units, vapor-tight incandescent fixtures over shower or bath, and especially from the interesting mirror lighting. This is from three suspended 75-watt incandescent lamps set deep in formed enclosing globes of dense opal glass.

In this home the architectural design, complemented by the lighting design, has achieved the objective of modern living in its finest form.

FOURTH PRIZE
CLASS I

m.i.l.j

Color–
Lighting–
Design–

three-way treatment to modernize an apartment

Entrance hall.

So TOTAL was the collaboration of decorator (Mr. Klein) and lighting specialist (Mrs. Hanrattty) for the success of this installation, that it was jointly entered as the most interesting job of both of them.

Light and lighting have been used as elements of the interior design, together with color and interesting decorative techniques, to transform one part of a 45-year-old house into a modern apartment. Typical of the old structure were high ceilings and virtually no windows in the living room. The challenge was to make such an unprepossessing space conform to the living requirements of both casual evenings and large scale entertaining. The need was three-fold: (1) an integrated color scheme; (2) interesting decorative detail, and (3) flexibility and variety through lighting.

The lighting installations themselves constitute the major architectural changes. The color scheme has good definition with its all white background, gold carpeting and various light and dark furnishing accents. Interest in decorative detail was brought about through the mixture of old and new — through related groupings of unrelated subjects and balance of decor through the placement of color. Accent colors are predominantly black, white, yellow and orange.

Lighting provides the flexibility and variety. Real candlelight in combination with fluorescent and incandescent light, for example, creates the desired atmosphere in the dining room (not shown). Dimmer controlled cornice and luminous ceiling, in combination with recessed spotlights and three-level portable lamps, permit the required sensation levels to be realized in the living room.

Entrance Hall

A wide distribution of low-level incandescent lighting in the entrance hall gives the desired welcoming note. For this 5-foot by 7-foot entrance hall, lighting is from five 18-inch luminous disks,

Martin Klein

Lucille Hanratty

Cleveland Section, Great Lakes Region

Mr. Klein is an Interior Designer in Cleveland, Ohio. Mrs. Hanratty is a Residential Lighting Consultant, and was with the General Electric Co., in Cleveland, at the time this installation was designed.

Living room.

each housing three 7½-watt lamps. The total effect is essentially that of a very low brightness luminous ceiling, especially since wall areas 11 inches from the original ceiling to the molding, as well as the entire top of the fixture, are painted a black-brown. Visually, the lighted disks are the ceiling. Plain wood slats were applied to the walls and the entire wall space is painted white.

Living Room

In the living room, more than in other areas, lighting has transformed the original architectural elements, especially those which were useless to a modern environment. Part of a cabinet, for instance, covers a previously existing window. Now one sees here 45 watts of fluorescent light over a photograph area, three R20 spots over the mantel (which has been lowered 15 inches). A high-back wing chair (lighted by portables) in orange plaid, is repeated at the south end of the room (shown in the photograph).

This picture wall is highlighted with six R20 spots and again only for decorative effect. The portable lamp houses a 30/230 lamp and creates the fourth reading spot in the room.

The only two outside windows in the 400-square-foot room are completely draped, first because no sunlight reaches them anyway and, second, because the scenery beyond them leaves too much to be desired. Consequently the designers ignored them and created their own controllable lighting levels and effects. A luminous ceiling seemed the best answer. This ceiling is dropped 12 inches from an original 9 feet 3 inches. Each two-foot-square panel is made of milk Plexiglas sandblasted on the visible side. The cavity above is white. Two rows of ten 40-watt fluorescent warm white deluxe lamps run parallel with the north and south walls, and one row of five tubes runs lengthwise between them. Lamps have been kept away from the walls as much as possible, to blend the light off and keep down the wall brightness.

With the dimming control for the ceiling, many moods may be created and, very important, the moods of guests also seem to be controlled to a great degree. Low-level lighting seems to keep even large gatherings in a vocally tip-toe state. Raise the level of lighting, and the level of animation is immediately increased.

With all the lighting equipment at high level it is possible to reach a measurement of 200 generated lumens per square foot, or an average over-all footcandle reading of 35 at 30 inches from the floor. With all the other equipment turned off and the ceiling dimmed to its lowest level, the moonlight reading measures about 2 footcandles. Even at full tilt, of course, the lighting is comfortable; quality factors in the entire visual environment having been as carefully controlled as any of the other design factors.

Making a Midnight Landmark

How it is done . . .

And how it looks.

FOURTH PRIZE
CLASS II

Floodlighting tall buildings, in the center of large cities, midst the congestion of busy streets, presents a very real engineering problem. Its solution has won prizes before. Mr. Watson's problem was floodlighting for the Canadian Bank of Commerce in downtown Toronto. This structure, tallest in the British Empire (476 feet), stands out against the Toronto skyline unchallenged for architectural supremacy and visibility.

To the usual problems of space, targeting, etc., were added several additional considerations. Of these, the most prominent were:

(1) An accumulation, for over 30 years, of soot and grime offered a poor reflection factor of 23 per cent for the building surface; in some locations as low as 19 per cent.

(2) Total load of the previous floodlighting installation (29 kw from 250- and 500-watt incandescent floodlights) was not to be exceeded in the relighting project, yet the level of illumination was to be raised considerably. It was specified that the building be visible for a radius of at least 6 miles, at the same time having distinction and dignity.

(3) Mounting locations were limited and distance or offsets were no more than 5 to 10 feet from the building face, with heights of 50 to 60 feet to be illuminated.

(4) Over-all architectural effect must be maintained. This included retaining desirable texture of the building, and maintaining the effect of the rows of gargoyles or stone heads which decorated the set-back.

The cost of cleaning the building at first seemed prohibitive, when Mr. Watson suggested this to the

G. T. Watson
Toronto Section
Canadian Region

Mr. Watson is a Lighting Specialist with the Amalgamated Electric Corp., Ltd., Toronto, Ont.

Close-up of floodlighted tower.

bank's owners. The new floodlighting installation proceeded without a solution to this problem. However, the advantages to be gained eventually were appreciated and cleaning was undertaken after completion of the floodlighting. Cleaning provided a new average reflection factor for the building surface of 53 per cent. In terms of footlamberts; after cleaning, 35.

Increasing the level of illumination without adding to the previous load called for careful selection of the light sources. The solution was a 140-watt sodium vapor discharge lamp giving 11,200 lumens, and having a nominal average life of 4000 hours. This not only met the load restrictions, but actually lowered it to a 26 kw total. One hundred and sixty four units were required for the job. The high efficiency lamp used greatly increased the illumination level over the previous installation, and by virtue of its golden amber color created the prominence and distinction desired.

With the source established, a reflector was the next solution required. A trough-shape Alzak reflector was designed, to give a horizontal spread of 147 degrees, and a vertical spread of 130 degrees.

The linear source dictated to some degree the shape of the reflector. An even distribution of light resulted from this design.

To obtain just the desired architectural lighting effect desired a walkie-talkie was used for targeting, with the owners taking part in the targeting instructions. Units were numbered so that either the engineers or the owner's representatives could suggest, via telephone, which unit might be adjusted for different effects. This also afforded the opportunity for adjusting to the best over-all effect as seen from ground level, where the installation would normally be viewed. Note from the illustrations that the gradation of light falls towards the highlighted corona, and that the huge stone heads are shown up in silhouette.

All concerned were pleased with this installation, and especially the people of Toronto for whom it has become a midnight landmark.

And More to Come . . .

On these last 18 pages the top national winning installations of the "My Most Interesting Lighting Job" contest have been shown. In future issues of IE, other worthy, and prize-winning, lighting jobs entered in these contests will be described. Since, in so many cases, the judging is close — there is more of the best to come.

Automatic Photometer for Street Lighting And Other Luminaires

By G. A. HORTON, R. C. SPECK
P. A. ZAPHYR, R. E. WENDT

This paper describes a street lighting photometer which is completely automated so that no hand transcription of the photometric data is necessary. The photometer which is automated has been described in the literature.[1] It is of the well-known single-mirror selector type.

The programming of the photometer has been accomplished by means of two tape readers, one to control the lateral orientation of the luminaire, and the other to control the vertical orientation of the selector mirror.

The measurements of luminous intensity are made by means of a microampere null-type strip chart recorder which measures the current produced by a barrier-layer type photocell, the current output of the photocell being proportional to the illumination upon the cell. The angular motion of the recorder slidewire is, at all times, proportional to the illumination upon the photocell, and an analog to digital encoder is mounted upon the slidewire shaft.

The readout from the encoder consists of a tape punch and an adding machine from which a trial balance of the luminaire efficiency may be made to check with the efficiency as measured in a photometric integrator. The tape from the punch is run through a tape to card converter where the information is punched onto IBM cards.

The reduction of the data in the cards to a useful photometric report is accomplished by a method described in the literature.[2]

The use of plastic tapes for programming the photometer makes it universal, as the program may be changed simply by changing the array of holes punched in the tape.

AT PRESENT, industry is in a period of change between the time when routine work was done by men, and the age in which it will be done by machines. In order to economically justify automatic equipment, there must be a reasonable payout period involved, say five years. Also, manpower costing rates must be considered.

Description of Automated Photometer Components

The completely automated photometer is shown in Fig. 1. In the left foreground may be seen the strip chart luminous intensity recorder containing the binary coded commutator. In the right foreground is seen the console containing, in the left half, two motorized tape readers, a remotely operated adding machine and a motorized tape punch. In the right half of the console are the program counters, the central program unit, the control chassis and the tape punch control. To the rear may be seen the single mirror selector photometer[1] with luminaire mounted for test, and in the background may be seen the screening box containing the barrier-layer photocell. All the various components will now be described in detail.

The basic elements of the programming system are the timing cams seen in Figs. 2 and 3. These timing cams actuate microswitches which send electrical impulses to actuate the tape readers. The spacing of the risers on the cams is such that impulses are sent out for each 2½ degrees of luminaire and mirror rotation. Driving power is obtained from two ⅛ hp synchronous motors.[3] These are coupled to the driven elements through variable speed transmissions[4] and electromagnetic clutches.[5]

In Fig. 4 are shown, from left to right, the motorized tape reader, the motorized tape punch and the remotely operated adding machine. The motorized tape reader,[6] as its name implies, is used for the reading of information from a punched paper or plastic tape. It is of the intermittently operating pin-sensing type where the operation is controlled by a cam shaft which makes one revolution to read each code. Operation of the shaft is by a built-in electromagnetic single revolution clutch for connecting the cam shaft to a continuously running drive pulley. In operation, the reading pins are caused, by a cam, to move under light spring tension into engagement with the tape while it is stationary. If there is a hole in the tape in register with a pin, the pin moves through the tape to a position causing an associated contact assem-

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AUTHORS: Westinghouse Electric Corp., Lighting Division, Cleveland, Ohio and Analytical Dept. and Manufacturing Engineering Laboratory, East Pittsburgh, Pa., respectively.
This paper accepted by the Papers Committee of I.E.S. as a Transaction of the Illuminating Engineering Society.

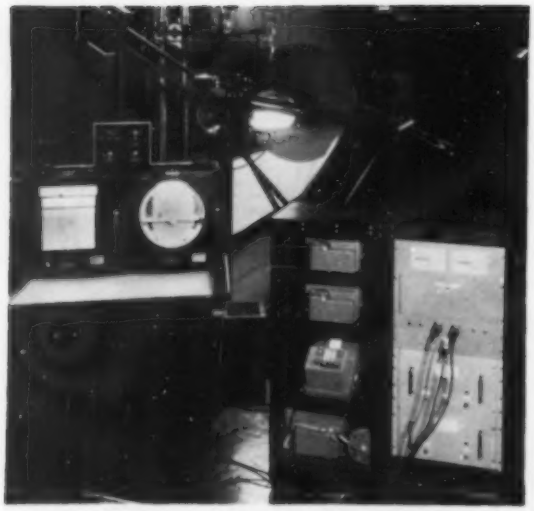

Figure 1. Automated photometer.

bly to operate, but if there is no hole at this point, movement of the pin is blocked by the tape and operation of the associated contact assembly is prevented.

The motorized tape punch[7] is designed for applications involving the recording of information in punched paper tape. It is capable of punching any number up to eight transversely spaced code holes. The unit is mechanically operated by a cam shaft which makes one revolution for each punching cycle. The cam shaft is controlled by an electromagnetic single revolution clutch which connects the cam shaft to a constantly running drive pulley. A feed hole is punched in the tape for each revolution of the cam shaft, and the code holes are punched by individual electromagnets during each revolution of the shaft. The clutch and code magnets are all controlled by external control circuits.

In the remotely operated adding machine,[8] solenoids operate the ten numeral keys as well as add, clear keyboard, print only, subtotal and total keys. The solenoids are activated by electrical pulses created by the associated equipment.

In Fig. 5 are shown the one-inch wide, plastic programming tapes which are read by the motorized tape readers mentioned above. One tape programs the lateral motion of the luminaire, while the other programs the vertical motion of the photometer selector mirror. The large holes in the tapes are the code holes and the small holes are the feed holes. Since the required length of tape is very small in each case, tape reels are not necessary and the tapes are simply glued together, end to end, and fed through the readers continuously.

The basic element of the photometric system is an angular position encoder[9] or commutator. This may be seen in Fig. 6, mounted behind the circular

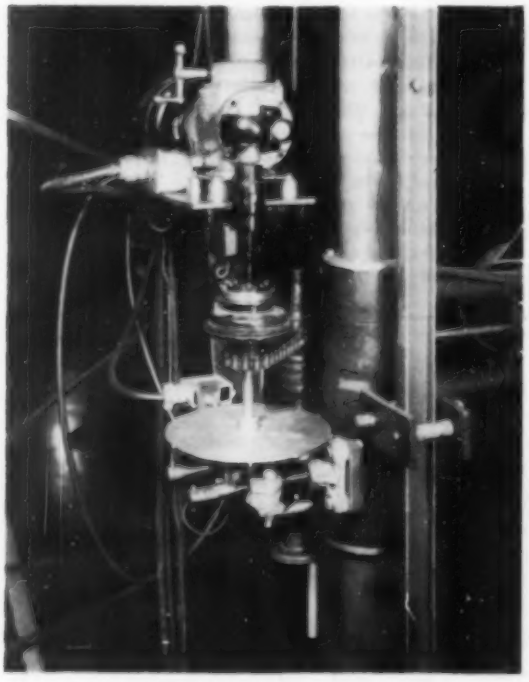

Figure 2. Lateral orientation timing cam.

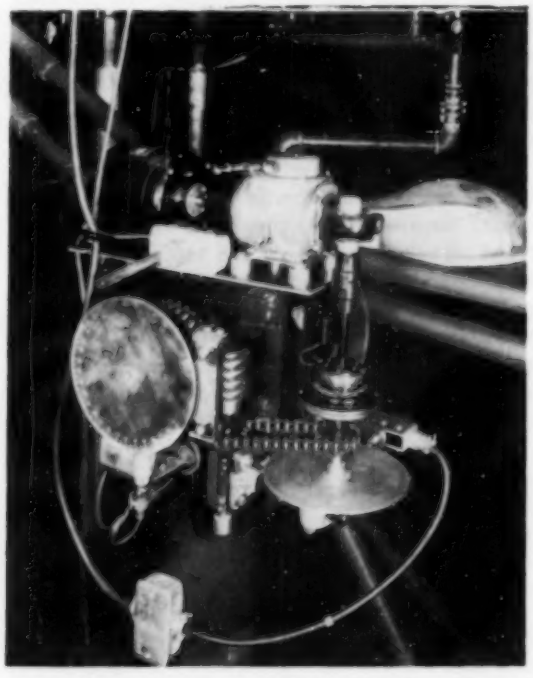

Figure 3. Vertical orientation timing cam.

Figure 4. (left to right) Motorized tape reader, motorized tape punch and remotely operated adding machine.

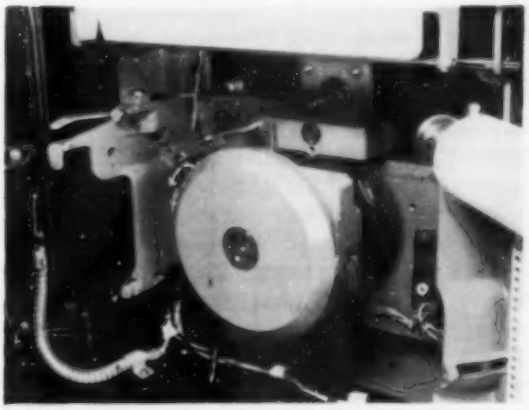

Figure 6. Angular position encoder.

slidewire assembly and in front of the large phenolic slidewire shaft gears of the null-type self-balancing recorder.[10] The recorder reads the current from the barrier-layer type photocell, this current being proportional to the light incident upon the cell. The encoder is used to convert the analog values of photocell current to digital values representing luminous intensities from the luminaire under test.

In the 1000-count commutator used, each decimal digit is represented by four binary-decimal coded rows of contacts on a disc. There are four rows of conductive segments for the units digit, four for the tens digit and four for the hundreds digit, making a total of twelve, each with its respective brush, and a thirteenth brush providing a common return circuit. The segments are so arranged that the coded output is different for each discrete angular position of the commutator, and also that only one symbol or brush contact changes as the disc moves from one point to the next, even though the number system changes by three symbols (*i.e.*, from 99 to 100). This eliminates the ambiguity of requiring three simultaneous and perfectly timed contact changes, and has the advantage that data may be recorded while the commutator is changing position.

In order to convert the binary-decimal information from the commutator into decimal form a con-

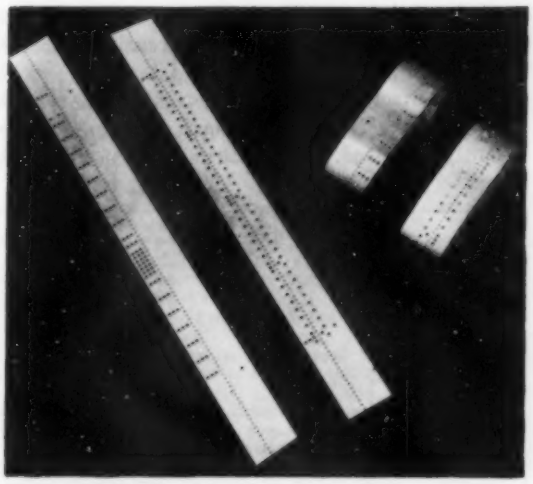

Figure 5. Programming tapes.

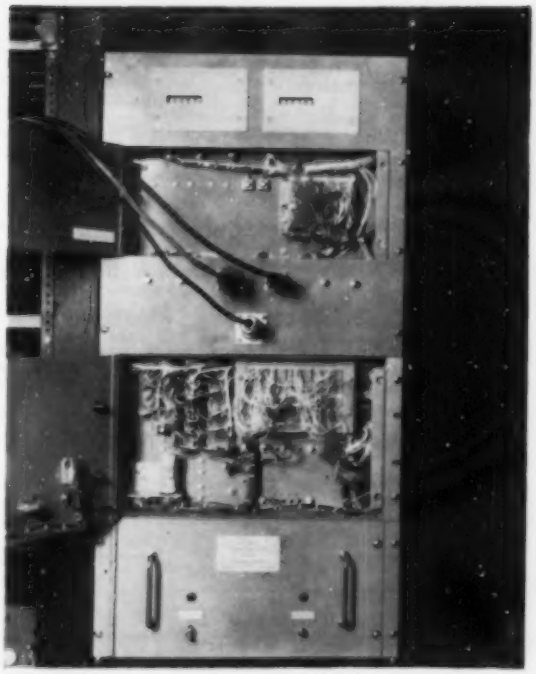

Figure 7. Central programming unit showing control chassis, etc.

Figure 8. Readout tapes and punch cards.

trol chassis is required. This is shown at the bottom panel in Fig. 7. This contains a translator consisting of 14 relays and associated circuitry which makes contact closures of a proper form to operate the recording device, the motorized tape punch previously described. Instantaneous readout of data is accomplished while the indicator of the self-balancing microampere recorder is in motion. This is done by the use of storage circuits consisting of twelve miniature thyratrons, with the control grid of each thyratron being connected to one of the twelve brushes of the commutator. When a control

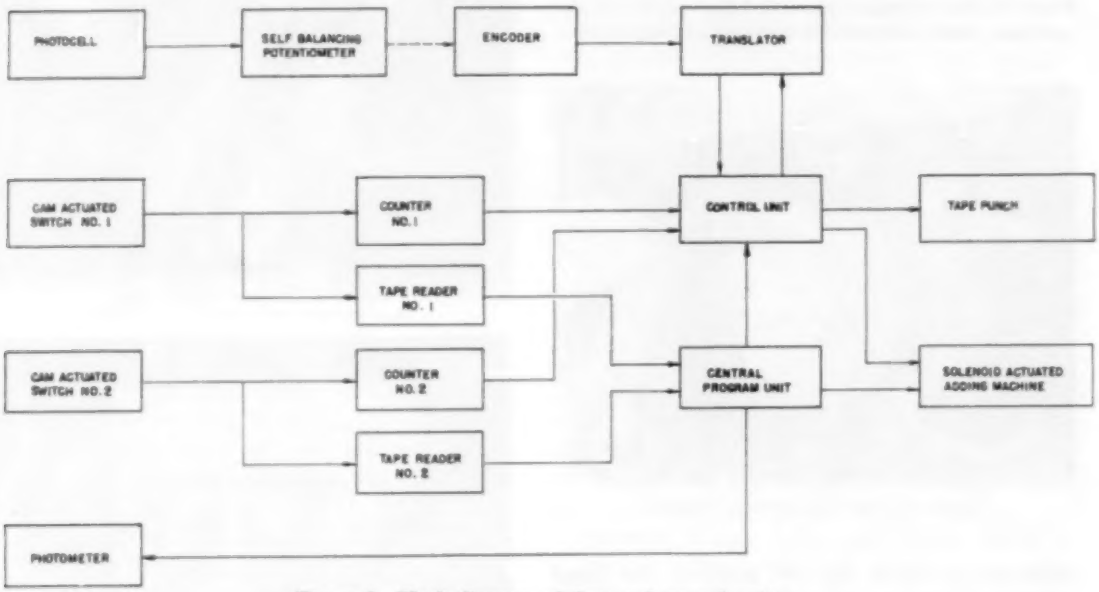

Figure 9. Block diagram of data and control units.

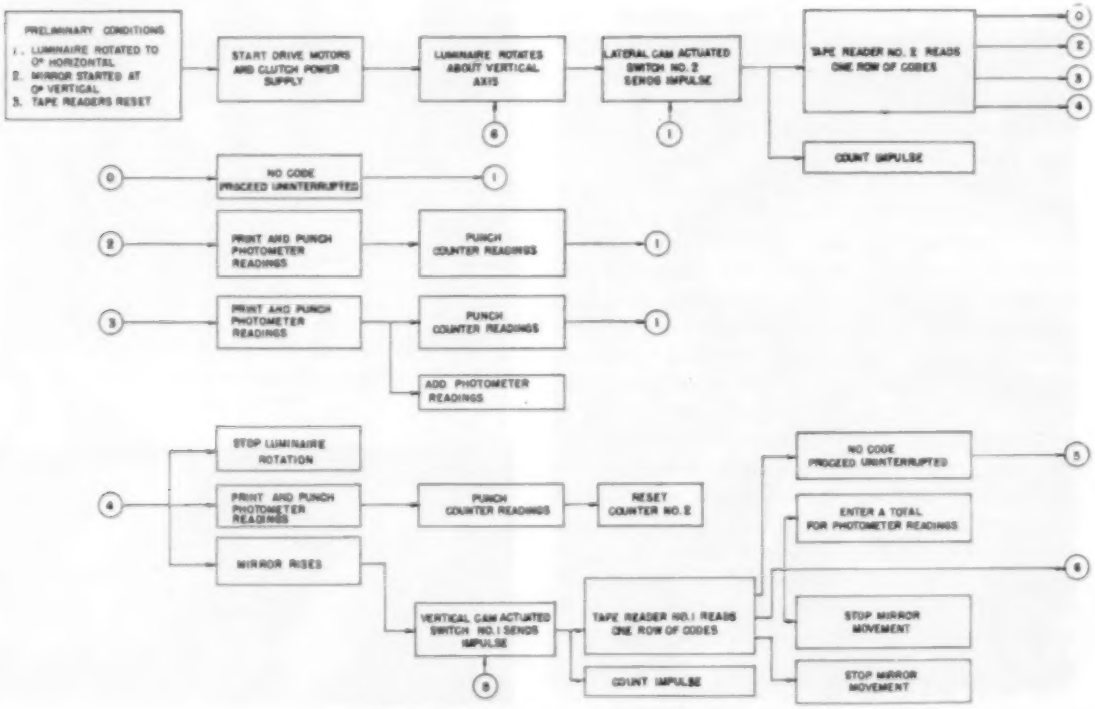
PRELIMINARY CONDITIONS
1. LUMINAIRE ROTATED TO 0° HORIZONTAL
2. MIRROR STARTED AT 0° VERTICAL
3. TAPE READERS RESET
START DRIVE MOTORS AND CLUTCH POWER SUPPLY
LUMINAIRE ROTATES ABOUT VERTICAL AXIS
LATERAL CAM ACTUATED SWITCH NO. 2 SENDS IMPULSE
TAPE READER NO. 2 READS ONE ROW OF CODES
COUNT IMPULSE
NO CODE PROCEED UNINTERRUPTED
PRINT AND PUNCH PHOTOMETER READINGS
PUNCH COUNTER READINGS
ADD PHOTOMETER READINGS
STOP LUMINAIRE ROTATION
MIRROR RISES
RESET COUNTER NO. 2
VERTICAL CAM ACTUATED SWITCH NO. 1 SENDS IMPULSE
TAPE READER NO. 1 READS ONE ROW OF CODES
ENTER A TOTAL FOR PHOTOMETER READINGS
STOP MIRROR MOVEMENT

Figure 10. Flow chart of operations.

contact is closed to initiate a readout, a 25-microsecond electrical pulse is sent to the common brush and thus to the conducting segments of the commutator. The brushes that are in contact with the conducting segments at that instant transmit the pulse to, and fire the associated thyratrons. The thyratrons remain energized until the recording cycle is complete, at which time the plate voltage is momentarily removed, extinguishing the thyratrons, thus clearing the storage.

Operation of Automated Photometer

A block diagram of the data and control units is shown in Fig. 9.

The sequence of operations may be easily followed in the flow chart of Fig. 10. This consists essentially of positioning the vertical traversing of the mirror to predetermined angles. At each of these predetermined vertical angles, the luminaire traverses through 360 degrees horizontally and impulses are sent, at the proper times, to the encoder to readout the photometer readings on the punch tape and adding machine tape as shown in Fig. 8. Since the luminaire makes many complete horizontal rotations during the course of a test , the power is brought to it by means of mercury cups.

The photometer readings in the centers of annular zones used for computing lumens are automatically added and totaled. The proper lumen constants may be applied to these sums and the computed efficiency, as established by this "trial balance," may be compared with the efficiency of the test luminaire as measured in a photometric integrator.[1] If this check is suitable, say within one or two per cent, then the photometer readings are converted into punch cards by means of an IBM Tape to Card Converter.

The progress of the program may be checked at any time for correct sequencing by means of two counters.[11] These may be seen at the top of the console in Fig. 7.

The system used in this automated photometer consisted of utilizing equipment already available such as the single mirror selector unit and the microampere recorder. Limitations, such as obtaining adequate test distance within a twelve-foot ceiling height, had to be observed.

The speed of operation of the equipment is limited by the balancing time of the microampere recorder which is two seconds across scale. However, a complete set of test data, consisting of approximately 900 photometer readings required for an asymmetric luminaire, may be taken in about one hour as compared with three or four hours for two technicians when the data were formerly transcribed by hand. Another advantage of using the recorders is that continuous shape curves of the luminous intensity may be automatically drawn while the photometric data are being automatically recorded on the punch tape and on the adding machine tape.

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DISCUSSION

W. B. ELMER:* The authors and their company deserve a generous measure of appreciation for the effort and expense they have devoted to further reducing the burdensome task of taking data and presenting reports of luminaire performance. This paper reveals one more small but gratifying step in the ever continuing process of applying the new tools of our civilization to its many laborious tasks. As in all such items of progress, however, one asks if the cost is reclaimed in the form of time and labor savings. The authors are urged to provide this information.

J. S. FRANKLIN:** The authors are continuing their gradual transition to fully automatic testing and they are to be congratulated for their pioneering work in this field.

Several questions arise when considering the use of this equipment in some typical lighting problems.

(1) How close together can readings be taken in the horizontal and vertical?

(2) What is angular accuracy of each position setting?

(3) What is speed of rotation of the drives, and is the horizontal rotation always operating at constant speed?

(4) Why is it necessary to convert from punched paper tape to cards prior to use on the IBM 704?

(5) Is it not possible to convert punched paper tape directly into magnetic tape?

(6) Is it possible to program any random sequence of horizontal and vertical angular settings, *e.g.*, when reading points along longitudinal roadway lines?

(7) Have the authors considered using the same program unit and readout device in conjunction with other photometers in the laboratory?

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F. M. NEAL:* This paper shows how the use of ingenuity, time and equipment has produced an automatic photometer that greatly decreases the man-hours necessary for taking and processing routine photometric data. Of special interest to the photometrist, besides the automatic operation, is the use of the adding machine for giving luminaire efficiency. This makes a lumen summation available for immediate comparison with integrating sphere measurements, thus enabling the luminaire to be removed from the photometer with confidence, knowing that the photometer calibration and mechanical operation are correct. The variable speed transmissions are also of interest because they make it possible to run the photometer at the maximum speed consistent with recording equipment and luminaire distribution.

It should be remembered that an automatic photometer is an aid to, and not a replacement for, a photometrist. It allows him to accomplish more by removing the routine procedures of operating the photometer and taking data. This allows him to concentrate his energies on photometer calibration and luminaire setup.

For development work on luminaires having asymmetrical light distributions, we have found it necessary to take candlepower distribution curves in vertical planes spaced not more than 10 degrees apart and three lateral curves in the region of maximum intensity. This is done in order to obtain a good visual picture of the light distribution. The curves taken in vertical planes can readily be converted into isolux and utilization curves, by the use of overlay curves and charts, in about four man-hours. The added man-hours that a non-automatic method requires over that described by the authors can be justified for design work where immediate results are desired.

E. H. SALTER:** The authors are to be congratulated on extending the work previously reported on machine computations to now include automatic machine-recording of data. Time saving in running a test on this equipment is compared with a completely manual operation. Motor-driven goniometers and curve drawing recorders have cut the man-time required for testing to something less than half that required for the older manual job. Of course, this still leaves a factor of possibly two or three in favor of the automated equipment.

The major saving, however, is in computing time when punched card records can be fed into one of the larger programmed computers. All of this automation and machine computing is in the direction of economy when there is, within the company, a computer that is not loaded to full capacity. Owning costs on these computers are exceedingly high and require a high use factor to justify them, hence the more work thrown in this direction, the lower the cost per individual job.

The company that I represent is too small to own or justify renting a programmed computer of a type to carry through these computations. To make use of the time saving through machine computing, we would have to resort to the use of one of the computing centers that have sprung up in various large cities. But even that may not prove to be an appreciable saving in the long run.

For example, in one instance in which full programming was furnished to the computing center, the computing center would take no responsibility for results obtained without first checking this programming — for a fee of $500. After payment of that fee, the charge would be of the order of $25 for a computation. This same job can be done manually in about half a day.

From this I believe that it may be shown to be just as economical for the small laboratory operating as an independent unit to do computations by the older manual-machine methods. In fact, in such cases there appears to be no other choice.

R. L. SMITH:* This sequel to the authors' paper of last year, published in ILLUMINATING ENGINEERING in June 1958, is a most interesting addition. The succinct nature of the information suggests that it was fed at least once through an IBM to shorten the reading time. This calls for more description.

I would be further interested in the methods used for synchronizing the entire system. Is this achieved completely by the programming tapes or are other devices needed?

The balancing time of our microampere recorder is one second for full scale. I note yours is two seconds. Is the extra time needed because of inertial drag of the encoder located on the same shaft as the circular slide wire?

Are you limited to but one swing of the slide wire, *i.e.*, one calibration per test, or can you recalibrate the recorder for low intensities as the test progresses to lower candlepower values? If possible, does the tape punching device record this automatically without attention on the part of the operator?

G. A. HORTON:** The authors wish to thank all the gentlemen who discussed the paper.

In reply to Mr. Elmer, we believe that the pay-out period of five years mentioned in the first paragraph of the paper should be satisfactory.

In reply to Mr. Franklin, we believe that the closeness together of angles at which readings may be taken is a function of the diameter of the timing cams and how many risers it is possible to place upon their peripheries. With the diameter of the present timing cams in use, it appears it would be possible to take photometric readings at one-half-degree intervals.

We feel that the angular accuracy of the position settings is within ± 0.1 degree. The speed of rotation of the drives is adjustable within a range such that the luminaire and mirror may rotate at one revolution within two and a half to four minutes.

There is normally no paper tape input on an IBM Type 704 computer such as we use, and we do not plan to obtain the modification because of the low volume of work for which it would be used. For this reason, it is necessary to convert from punched paper tapes to cards for input to the computer.

We believe it is possible to convert punched paper tape directly into magnetic tape but in our case there would be no advantage, since our original IBM 704 program was for card input, which was modified slightly to take the new card format from the digital encoder. We would have had to acquire paper to magnetic tape equipment which could not actually have been justified because of the relatively low computer loading due to luminaire calculations.

It is possible to program random settings of horizontal and vertical angles if taken in sequence. However, this would tend to slow up the data taking process somewhat,

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**Electrical Testing Laboratories, New York, N. Y.

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**Co-Author.

since photometer motion would have to be stopped for each individual reading instead of taking them on the fly as we do now in the regular street lighting exploration. We would prefer a computer method using standard exploration.

We believe the same program and readout units have the flexibility required for application to other types of photometers in our laboratory.

In reply to Mr. Neal, we believe that the remarks made in the first two paragraphs of his discussion are correct. The remarks made in the last paragraph are also correct, particularly if the digital computer equipment associated with the automatic photometer is not in the immediate vicinity of the photometer or should happen to be temporarily tied up on other jobs.

In reply to Mr. Salter, we believe that his remarks with regard to presently available computing equipment and services are correct. We do feel, however, that photometer automation might prove valuable to organizations such as that which he represents, since the photometer readings may be printed out as well as punched in the punch tape.

In reply to Mr. Smith, we wish to state that the programming device really consists of the programming tapes plus the timing cams and associated equipment including the tape readers, relays, etc. The timing cams are connected to the moving elements of the photometer by means of gears and sprockets and thus always remain synchronized. This means that the system is thus independent of the speed of luminaire rotation so that at the exact instant a reading station is reached (within the tolerances of the mechanical design), an electrical impulse is sent to the readout device and the photometric reading is punched in the paper tape and printed out on the adding machine tape.

As the programming tape moves through the horizontal tape reader, it initiates such processes as printing and punching photometer readings, punching sequencing counter readings, adding photometer readings to be included in the trial efficiency balance, etc. At the end of each lateral traverse, a signal is sent to the vertical tape reader to advance the mirror to a new elevation and the horizontal tape reader then repeats its cycle.

With regard to microampere balancing time, our recorder was one of the first of these produced and designs had not yet advanced to the point of the one-second balancing time across the chart. There is no inertial drag of the encoder which would tend to slow up balancing time.

We have found that it is possible to take all readings for one luminaire test on one range of the recorder and this checks very well with a hand transcription of the same data. The tape punching device does not monitor photometer calibration, but the technician may check the condition of the recorder reference battery which is the main source of calibration drift in the system. This is usually done when the luminaire rotation is stopped to change the photometer mirror to a new elevation.

Floodlighting Niagara Falls

(Discussion of a paper by W. A. Dalrymple and C. A. Albini, published in the October issue of ILLUMINATING ENGINEERING)

A. E. KRAWCEK:* Obviously a great deal of work was necessary to design and install the lighting equipment in this installation. It seems, therefore, that the authors are somewhat modest in stating that the lighting of such a project presents no more of a problem than many others.

I wonder if there is any information available as to the amount of illumination obtained with the old as well as the new systems; either brightness or calculated illumination? What are the angular dimensions of the beams with the Cathedral and the fluted glass?

It would be interesting to know more about the maintenance problems in an installation of this nature. How long do the cinemoid gelatins last? Do the reflectors need to be resilvered frequently?

If I understand correctly, the choice of colors and their combinations for the twenty projectors is strictly up to the operator. Does this operator have any guidance in this procedure? It would seem that unless the operator were of an artistic inclination, there would be a definite advantage in a predetermined sequence of colors, possibly one which could be altered from time to time.

W. A. DALRYMPLE AND C. A. ALBINI:** The comparisons of the old and new installations are given herewith in terms of brightness. With the old installation, 0.3 footlambert, and with the new 5.5 footlamberts for the same beam spread. With the fully focussed beam on the new searchlights, the brightness on the Falls is 14 footlamberts and with the fan shaped beam, the type generally used, the brightness is 1.5 footlamberts.

The angular dimensions of the beam with the two types of glass are: Cathedral glass, approximately 3½ degrees; fluted glass which gives a fan shaped beam, 13 degrees in the horizontal and 2 degrees in the vertical.

As to the life of the cinemoid, this color media was in use previously, but open to the elements and we were informed that, generally speaking, they lasted about six months. The same media used in a weather-proof enclosure should last between nine and twelve months before there is any appreciable fading of colors from heat. It is not anticipated that the reflectors will require resilvering frequently, as the back of the mirror is copper-plated and further protected by a covering of lead sheet.

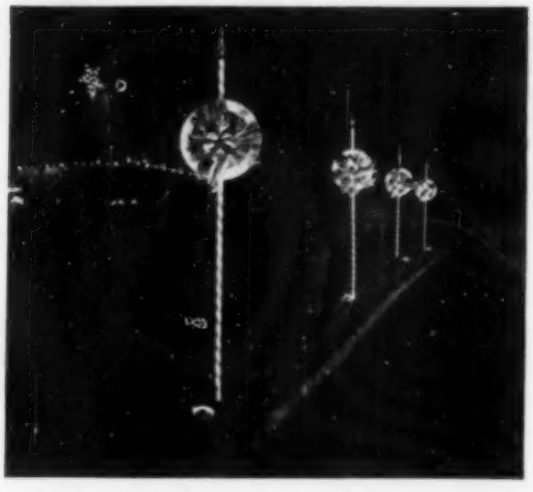
While we have no actual control over the actions of the operators, a definite color program was drawn up and submitted by us. To the best of our knowledge, this program is being used. A fully automatic color sequence, originally proposed, was turned down by the customer who felt it was undesirable. The semi-automatic system provides great flexibility and is, of course, much simpler mechanically which is what the customer desired.

*Crouse-Hinds Co., Syracuse, N. Y.
**Authors.

Celebrate Christmas

Your whole house — its doorways, windows and roof — and the shrubbery and driveway, too, can be a canvas upon which to paint a holiday picture in light. Each illustration on these pages shows several types of lighting integrated to give one over-all composition. Such coordination of display is the secret of beautiful Christmas lighting. Without over-all planning, the total effect can become gaudy.

Apartment dwellers can light their doorways too. This entrance door on the elevator corridor inside a large building is outlined with C-7½ lights and artificial greens. (Natural greens would dry out and be a fire hazard in the steam-heated building.) The large bell shape is cut from green cardboard with the top and bottom painted gold and sprinkled with gold glitters while still wet. The center decoration is a ready-made spray of "Swedish bells" in plastic foam to which a 7-light series string of tiny spherical G-6 bulbs has been added. Caution: whenever using Christmas lights and plastic foam, be sure that the hot bulbs do not touch the plastic — it will melt.



Decorate your driveway, too. These wreaths are actually circles of wood painted bright red with a center spray of greens, white boughs, red ribbon and silver balls. The white poles are wrapped diagonally with red plastic ribbon and capped with a tree-top ornament. A 150-watt PAR spotlamp at the base of each pole makes the scene more striking by night than by day.

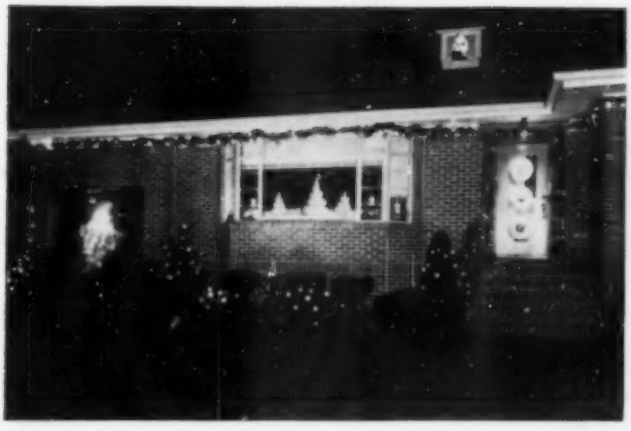
←

The owner of this house is *not* an illuminating engineer, but his Christmas lighting resourcefulness might still be an inspiration to some IES-members. In addition to the year-round lighting of this doorway from a fixture recessed above the door, the owner added dramatic spotlighting of the door decoration from an optical projector-type picture lighting unit in the same recess. Note the arc of the sharp cut-off of this beam. The door is wrapped in satiny green paper to which the family applied gold cutouts and Christmas balls. An added touch are the two miniature lighted trees in pots flanking the doorway. Floodlights located on the lawn show off the beauty of the woodwork detail.

AUTHOR: Home Lighting Consultant, Westinghouse Electric Corp., Bloomfield, N. J.

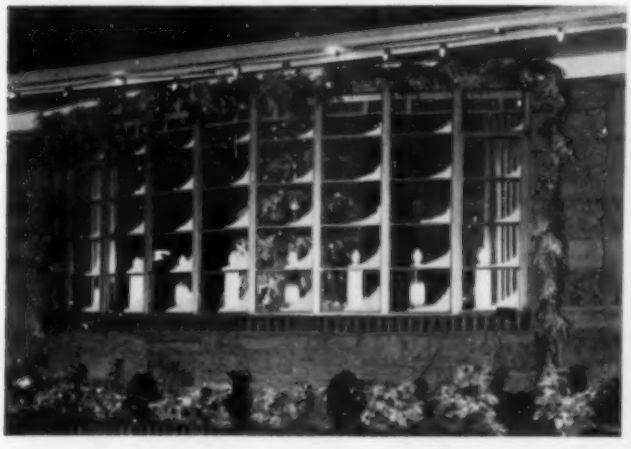
With Light

By EVE FREYER



Three white wreaths spotlighted from above on the front door are balanced by a spotlighted white spray on the garage door at the left. The "snow" scene in the bay window is backed by a black cloth studded with small clear bulbs shining through holes piercing the cloth. (Inside the room the draperies drawn across the window hide the black cloth and wiring from view in the living room.) A plastic Santa Claus with bulb inside is fastened to the chimney. All the decorations are unified outdoors by evergreen roping entwined with lights outlining the front facade and lights in the shrubbery. The entire front of the house is floodlighted.

This "stained glass" window is made of colored silk fastened inside the glass and lighted from indoors. The star-cross symbol above the doorway is lighted by one bulb in the center and shielded from the front by a metal cup. Strings of C-9½ lights in the evergreen trimming and a floodlight on the lawn complete the holiday picture. An illuminating engineer does live here.



Here is the traditional Christmas "light in the window," multiplied many times. Each home-made jumbo "candle" is a cylinder of translucent plastic (alternate red and green along the window sill) set over a 25-watt bulb in a porcelain socket mounted on a wood block. Each glowing candle is topped with a flame shaped bulb. Strings of multi-colored Christmas lights outline the roof outside, and evergreen roping frames the window.

A colorful three-dimensional plastic Santa Claus (which comes with lights inside) climbs a laurel- and light-trimmed ladder to the festooned chimney. This entire corner of the house is floodlighted by PAR lamps mounted in a nearby tree.

Efficiency of Flashing Lights

By THEODORE H. PROJECTOR

THE EFFECTIVE intensity of a light flash, when seen as a point source at threshold, is given by the Blondel-Rey equation:

$$I_e = \frac{\int_{t_1}^{t_2} I\,dt}{.2 + (t_2 - t_1)} \qquad (1)$$

where I is the instantaneous intensity during the flash, and t_1 and t_2 are times in seconds near the beginning and end of the flash.

When Blondel and Rey first proposed the equation in 1911, they recognized that there might be a difficulty in the use of the equation because of an uncertainty as to the choice of the limits of integration, t_1 and t_2.

Since the original work of Blondel and Rey, the validity of the equation has been amply confirmed,[1] although the ambiguity with respect to the limits of integration was not cleared up until recently, when Douglas proposed that the limits, t_1 and t_2, be chosen so as to maximize I_e.[2] Douglas' method is especially useful in the numerical specification of effective intensity and, in general, in the quantitative evaluation of flashing lights.

A similarly precise method for computing the efficiency of flashing lights is the subject of this paper. The efficiency of flashing lights consists of two parts: first, the efficiency of conversion of electrical energy to luminous energy and second, the efficiency with which a given amount of luminous energy is used to produce an effective flash of light, or effective intensity, in accordance with the Blondel-Rey equation. The over-all efficiency, combining both parts, might be termed the "effective efficiency" of a flashing light. The first part of the term, that is, the luminous efficiency or the efficiency of conversion of electrical to luminous energy, can be measured conventionally. It is proposed that the second part be designated the Blondel-Rey Merit Factor ($M_{B\text{-}R}$), and that it be defined so as to provide a measure of the efficiency with which a given quantity of luminous energy is utilized to produce effective intensity.

Before defining $M_{B\text{-}R}$, it may be useful to note that the Blondel-Rey equation can be expressed in a number of equivalent forms, referring to intensity, illuminance, or flux. In each case it is understood that the flash is seen as a point source at threshold. Thus the "effective illuminance" at the observer's eye is given by

$$E_e = \frac{\int_{t_1}^{t_2} E\,dt}{.2 + (t_2 - t_1)} \qquad (2)$$

and the "effective flux" emitted by a flashing light source is given by

$$F_e = \frac{\int_{t_1}^{t_2} F\,dt}{.2 + (t_2 - t_1)}. \qquad (3)$$

For the purpose of evaluating the efficiency of a flashing light in a manner analagous to the evaluation of steady-burning light sources, the last form of the Blondel-Rey equation, equation 3, is the most useful, and will be used in the following discussion.

To arrive at a definition of the Blondel-Rey Merit Factor, consider a flash of light with the time distribution of flux shown in Fig. 1. The effective flux for this light is given by

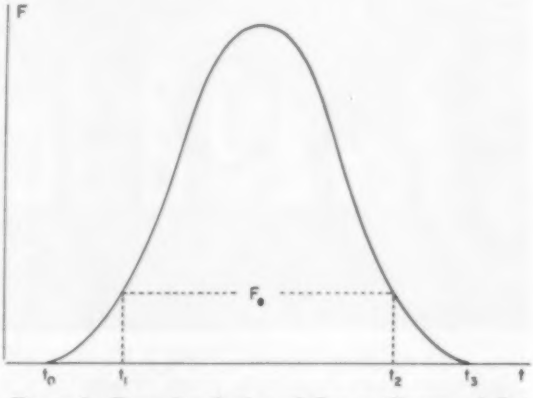


Figure 1. Time distribution of flux to illustrate definition of Blondel-Rey Merit Factor. t_0 and t_3 are the beginning and end of the flash, respectively. t_1 and t_2 are chosen so as to maximize F_e in equation 4. The instantaneous value of F at t_1 and t_2 is equal to F_e.

AUTHOR: Consulting Engineer, Kensington, Md.

$$F_e = \left[\frac{\int_{t_1}^{t_2} F\,dt}{.2 + (t_2 - t_1)} \right]_{\max.} \tag{4}$$

It will be noted that the numerator of the expression in the brackets is the luminous energy emitted in the flash between the times t_1 and t_2.

For very short flash durations, where $t_2 - t_1$ is extremely small compared with 0.2, F_e approaches a limiting value

$$F_e = \frac{\int_{t_0}^{t_3} F\,dt}{.2}. \tag{5}$$

The numerator is now the total luminous energy in the flash, Q_{lum}. The limiting value of F_e, that is, $Q_{\text{lum}} \times 5$, is the maximum F_e that can be obtained with this amount of luminous energy.

It is proposed that the Blondel-Rey Merit Factor, $M_{B\text{-}R}$, be defined as five times the ratio of the effective flux to that effective flux which would be obtained if the same luminous energy were compressed into a flash of extremely short duration, or

$$M_{B\text{-}R} = 5 \frac{\left[\dfrac{\int_{t_1}^{t_2} F\,dt}{.2 + (t_2 - t_1)} \right]_{\max}}{\dfrac{\int_{t_0}^{t_3} F\,dt}{.2}}. \tag{6}$$

$$M_{B\text{-}R} = \frac{F_e}{\int_{t_0}^{t_3} F\,dt}. \tag{7}$$

The denominator of equation 7 is equal to the total luminous energy in the flash, Q_{lum}, so that

$$M_{B\text{-}R} = \frac{F_e}{Q_{\text{lum}}}. \tag{8}$$

$M_{B\text{-}R}$ is essentially dimensionless as defined in equation 6, although in the final form of equation 8 it appears to have the dimension t^{-1}. The dimension t is concealed in the constant coefficient 1 in the equation, thus canceling out the dimension t^{-1} of F_e/Q_{lum}. (One of the effects of introducing the multiplying factor 5 in the definition is to make the coefficient 1.) F_e/Q_{lum} has the dimensions of flux/energy, expressible in lumens/lumen-second. The significance of this ratio is clarified if it is remembered that F_e is defined as the flux emitted by a steady-burning light whose intensity distribution appears equal to that of the flashing light. Q_{lum} on the other hand is the total luminous energy in the flash. F_e is related to the intensity distribution of a steady light in the same way that Q_{lum} is related to the intensity distribution of a light flash of very short duration. While $M_{B\text{-}R}$ should be recognized as dimensionless from a rigorous point of view, it is suggested that it be expressed nevertheless in its apparent dimensions of flux/energy in order to retain the significant relationship to the equivalent steady light, with the proviso that the flux be given in "effective lumens" rather than "lumens."

$M_{B\text{-}R}$ varies between the limiting values of zero and five. For a flash of extremely long duration, $M_{B\text{-}R}$ approaches zero. For a flash of extremely short duration, $M_{B\text{-}R}$ approaches five. For ordinary condenser-discharge lamps where the duration is of the order of a fraction of a millisecond, $M_{B\text{-}R}$, for practical purposes, is equal to five.

The "effective efficiency" of a flashing light may now be defined as the product of the luminous efficiency and the Blondel-Rey Merit Factor, or

$$\text{Efficiency}_e = \frac{Q_{\text{lum}}}{Q_{\text{elec}}} \times M_{B\text{-}R}. \tag{9}$$

Since $M_{B\text{-}R} = F_e/Q_{\text{lum}}$ (equation 8)

$$\text{Efficiency}_e = \frac{F_e}{Q_{\text{elec}}} \tag{10}$$

typically in effective lumens/watt-second.

The above discussion is based on consideration of a single isolated flash. In the case of repetitive flashes the above treatment can be used by considering t_0 and t_3 as the beginning and end of a flashing cycle, and equation 10 holds as before.

F_e is obtained by methods analogous to those used to obtain F for steady-burning light sources. If, for example, a time distribution of flux is measured in an integrating sphere, then F_e is obtained from equation 4. Or F_e can be obtained from distributions of I_e by the application of zonal constants and summation in the same way that F is obtained from distributions of I for a steady-burning lamp.[3]

In all the above, threshold illuminance at the observer's eye was assumed. If the illuminance is above threshold the value of the constant, .2, in equation 1, decreases.[1] For the general case, with the constant a substituted for its threshold value, .2, equation 8 for $M_{B\text{-}R}$ becomes

$$M_{B\text{-}R} = 5a\frac{F_e}{Q_{\text{lum}}}. \qquad (11)$$

The implications of this general expression for $M_{B\text{-}R}$ can be understood by examination of the definitional equation 6, rewritten in general form:

$$M_{B\text{-}R} = 5\frac{\left[\dfrac{\int_{t_1}^{t_2} F\,dt}{a + (t_2 - t_1)}\right]_{\max}}{\dfrac{\int_{t_0}^{t_3} F\,dt}{a}}. \qquad (12)$$

As a is reduced in value, both the denominator and numerator increase in value. The denominator is inversely proportional to a, but the numerator, for flash durations which are not negligible compared to a, increases at a slower rate than the denominator. Thus for a given flash, as the effective illuminance is raised above threshold, $M_{B\text{-}R}$ decreases. The limiting values are still zero for a flash of very long duration and five for a flash of very short duration. The longer the duration of the flash, the greater the reduction of $M_{B\text{-}R}$ with increase of illuminance.

The equation for effective efficiency for a generalized value of a is

$$\text{Efficiency}_e = 5a\frac{F_e}{Q_{\text{elec}}}. \qquad (13)$$

A few numerical examples may be helpful in clarifying the methods of computing the Blondel-Rey Merit Factor and effective efficiency. These examples have been devised to illustrate the computations and have not been drawn from actual measurements. The values therefore should not be considered representative of the types of light sources mentioned.

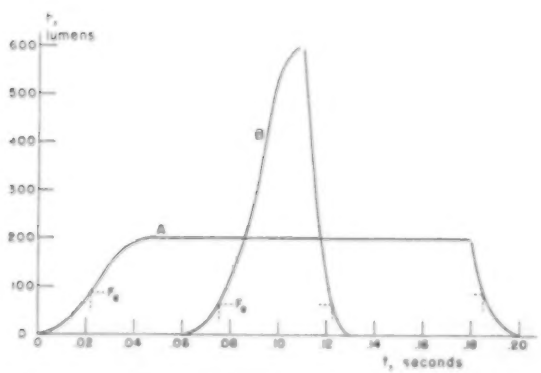


Figure 2. Time distributions of flux of electrically flashed incandescent lamps for example 1 (curve A) and example 2 (curve B).

Example 1

An incandescent lamp is flashed electrically, and a distribution curve of flux *vs.* time is obtained in an integrating sphere with the result shown in Fig. 2, curve A. It is found that the electrical energy consumed by the lamp, per flash, is 2.4 watt-seconds. Find $M_{B\text{-}R}$, the luminous efficiency, and the effective efficiency.

F_e is calculated from the distribution curve with equation 4, and turns out to be 87 effective lumens. Q_{lum} is the total luminous energy in the flash and is obtained from the total area under the distribution curve. Its value is 32.6 lumen-seconds. Substituting in equation 8:

$$M_{B\text{-}R} = \frac{F_e}{Q_{\text{lum}}} = \frac{87}{32.6} = 2.7 \text{ eff lum/lum-sec.}$$

The luminous efficiency is given by

$$\frac{Q_{\text{lum}}}{Q_{\text{elec}}} = \frac{32.6}{2.4} = 13.6 \text{ lum-sec/wt-sec.}$$

From equation 10,

$$\text{Efficiency}_e = \frac{F_e}{Q_{\text{elec}}} = \frac{87}{2.4} = 36 \text{ eff lum/wt-sec.}$$

Example 2

An incandescent lamp is flashed electrically, as in example 1, and its flux-time distribution is represented by curve B of Fig. 2. It consumes 1.35 watt-seconds per flash. Find $M_{B\text{-}R}$, the luminous efficiency and the effective efficiency.

The calculations are carried out as in example 1, with the result that $F_e = 65$ effective lumens and $Q_{\text{lum}} = 16.5$ lumen-seconds.

$$M_{B\text{-}R} = \frac{F_e}{Q_{\text{lum}}} = \frac{65}{16.5} = 3.9 \text{ eff lum/lum-sec.}$$

$$\text{Efficiency}_{\text{lum}} = \frac{Q_{\text{lum}}}{Q_{\text{elec}}} = \frac{16.5}{1.35} = 12.2 \text{ lum-sec/wt-sec.}$$

$$\text{Efficiency}_e = \frac{F_e}{Q_{\text{elec}}} = \frac{65}{1.35} = 48 \text{ eff lum/wt-sec.}$$

Example 3

A condenser discharge lamp is flashed in an integrating sphere and a flux-time distribution is obtained with the result shown in Fig. 3. The lamp

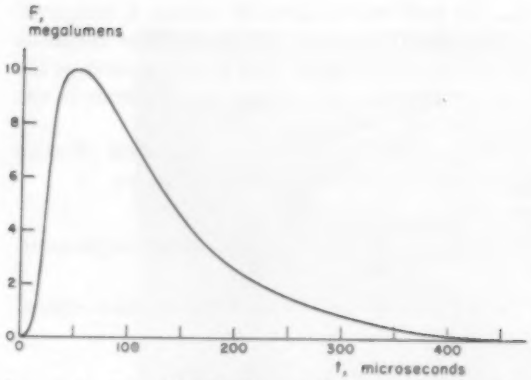


Figure 3. Time distribution of flux of condenser-discharge lamp for example 3.

is flashed by an 80-microfarad condenser charged to 1000 volts and it is found that a residual charge of 150 volts is left on the condenser after the lamp is flashed. It is found that the input energy to the power supply is 95 watt-seconds per flash. Calculate the efficiency of the power supply, the Blondel-Rey Merit Factor, the luminous efficiency and effective efficiency of the complete equipment, and the luminous efficiency and effective efficiency at the lamp.

F_e, calculated from the curve of Fig. 3 with equation 4, is 7000 effective lumens. For practical purposes, t_0 and t_1 are indistinguishable, as are t_2 and t_3, so that the numerator of equation 4, for a light flash as short in duration as is the case here, is equal to the total luminous energy in the flash, or 1405 lumen-seconds.

$$M_{B\text{-}R} = \frac{F_e}{Q_{lum}} = \frac{7000}{1405} = 5.0 \text{ eff lum/lum-sec.}$$

The net energy discharged by the condenser into the flashtube is

$$\tfrac{1}{2} C (V_i^2 - V_f^2)$$

where C is the capacity of the condenser, and V_i and V_f are the voltages before and after discharge respectively. From the values given for these terms, $Q_{elec} = 39$ watt-seconds.

Since 95 watt-seconds per flash are consumed by the power supply, its efficiency is 39/95, or 41 per cent.

At the lamp,

$$\text{Efficiency}_{lum} = \frac{Q_{lum}}{Q_{elec}} = \frac{1405}{39} = 36 \text{ lum-sec/wt-sec.}$$

$$\text{Efficiency}_e = \frac{F_e}{Q_{elec}} = \frac{7000}{39} = 180 \text{ eff lum/wt-sec.}$$

For the complete system,

$$\text{Efficiency}_{lum} = \frac{Q_{lum}}{Q_{elec}} = \frac{1405}{95} = 14.8 \text{ lum-sec/wt-sec.}$$

$$\text{Efficiency}_e = \frac{F_e}{Q_{elec}} = \frac{7000}{95} = 74 \text{ eff lum/wt-sec.}$$

Example 4

A rotating beacon, with its axis of rotation vertical, presents the appearance of a flashing light whose effective intensity is constant at any azimuthal angle for a given angle of elevation. By standard methods the distribution of effective intensity with angle of elevation has been measured and found to be as shown in Fig. 4. It was found that $M_{B\text{-}R}$ varied with elevation angle, and this distribution is also shown in Fig. 4. The beacon rotates at 50 rpm, and the light source is a 60-watt incandescent lamp. The drive motor in the beacon consumes five watts. Calculate the luminous efficiency and the effective efficiency of the beacon, and the average Blondel-Rey Merit Factor.

At 50 rpm, the beacon takes 1.2 seconds to complete one revolution. The total power consumption of the unit, lamp plus motor, is 65 watts. In one revolution the electrical energy consumed will be $65 \times 1.2 = 78$ watt-seconds.

The light output will now be analyzed in terms of one complete revolution. Table I summarizes the computations.

Column 1 gives the angular intervals to be used in the computation. Column 2 gives the zonal constants corresponding to the intervals of column 1.[4] The zones are annular strips on a sphere whose polar axis is the axis of rotation of the beacon. The

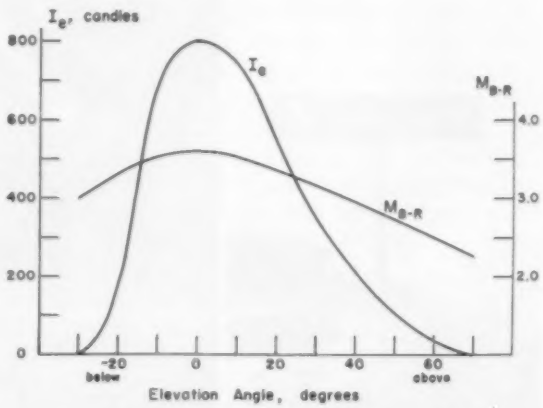


Figure 4. Data curves of an incandescent rotating beacon for example 4. The beacon rotates about a vertical axis. The curves show the variation of I_e and $M_{B\text{-}R}$ with angle of elevation.

TABLE I.

(1) Angular Interval on Graph, degrees	(2) Zonal Constant	(3) Average I_e, effective candles	(4) F_e, (2)×(3), effective lumens	(5) Average $M_{B\text{-}R}$ eff lum/ lum-sec	(6) Q_{lum}, (4)/(5), lum-sec
−30 to −20	.993	60	60	3.15	19
−20 to −10	1.058	440	465	3.43	136
−10 to 0	1.091	770	838	3.57	235
0 to 10	1.091	780	849	3.57	238
10 to 20	1.058	650	687	3.44	200
20 to 30	.993	440	437	3.26	134
30 to 40	.897	280	251	3.05	83
40 to 50	.774	160	124	2.83	44
50 to 60	.628	70	44	2.61	17
60 to 70	.463	15	7	2.38	3
	Totals:		3762		1109

zones are bounded by the elevation angles of column 1. The average I_e for each zone, estimated from the curve of Fig. 4, is given in column 3. The product of the zonal constant and the average I_e for each zone is the effective flux for that zone and is shown in column 4. The sum of the entries in column 4 is the total effective flux for the beacon, 3762 lumens.

In column 5, the average value of $M_{B\text{-}R}$ for each zone is shown, as estimated from the graph of Fig. 4. From equation 8 for $M_{B\text{-}R}$, it is evident that

$$Q_{lum} = \frac{F_e}{M_{B\text{-}R}}.$$

Q_{lum} for each zone is given in column 6, computed by the above equation. The sum of the luminous energies in all the zones, 1109 lumen-seconds, is the total luminous energy emitted by the beacon in one revolution.

The average value of $M_{B\text{-}R}$ is the total effective flux divided by the total luminous energy, or

$$\text{Aver. } M_{B\text{-}R} = \frac{\Sigma F_e}{\Sigma Q_{lum}} = \frac{3762}{1109} = 3.39 \text{ eff lum/lum-sec.}$$

The luminous efficiency and the effective efficiency of the beacon are as follows:

$$\text{Efficiency}_{lum} = \frac{Q_{lum}}{Q_{elec}} = \frac{1109}{78} = 14.2 \text{ lum-sec/wt-sec.}$$

$$\text{Efficiency}_{e} = \frac{F_e}{Q_{elec}} = \frac{3762}{78} = 48 \text{ eff lum/wt-sec.}$$

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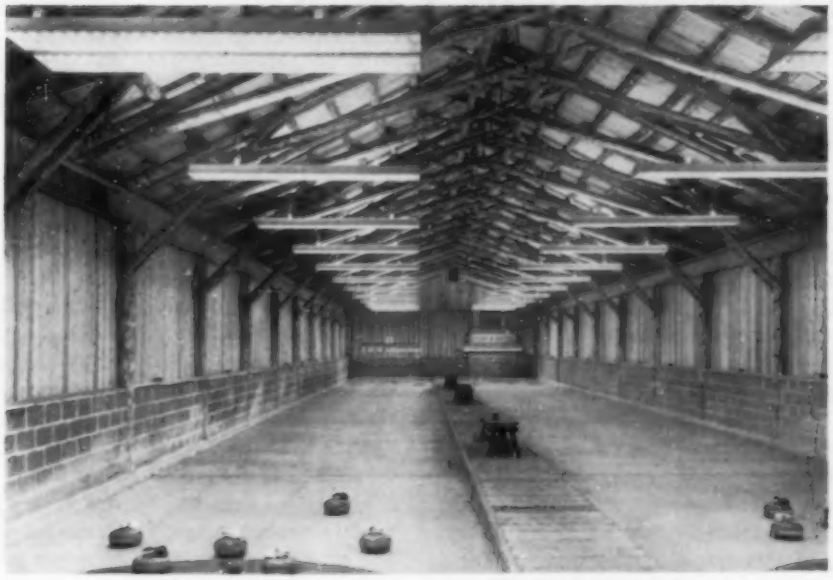
1. Projector, T. H.: "Effective Intensity of Flashing Lights," ILLUMINATING ENGINEERING, Vol. LII, No. 12, p. 630 (December 1957).
2. Douglas, C. A.: "Computation of the Effective Intensity of Flashing Lights," ILLUMINATING ENGINEERING, Vol. LII, No. 12, p. 641 (December 1957).
3. Projector, T. H.: "The Use of Zonal Constants in the Calculation of Beam Flux from Candlepower Distribution Data," ILLUMINATING ENGINEERING, Vol. XLVIII, No. 4, p. 189 (April 1953).
4. "Constants for Use in the Zonal Method of Computing Luminous Flux from Candlepower Data," Table A-15 (Appendix), *IES Lighting Handbook*, Second Edition, published by the Illuminating Engineering Society, New York, N. Y.

NEW SUPERHIGHWAY marking sign, with letters composed of from one to three individual electroluminescent lamps, was demonstrated recently before the annual conference of the California Division of Highways Electrical Engineers. The sign had been tested by the Division on the Roseville Freeway.

The lamp letters of the 4- by 16-foot sign are mounted on a marine plywood backing and covered by a Plexiglas window. Upper case letters are 18 inches high and lower case 12 inches. All are 1/16-inch thick. The sign operates with a 580-volt control device on conventional 60-cycle 115-120-volt supply.

The bright beam of light in the center of this time exposure photograph is from passing headlamps. Photo and data courtesy Sylvania Electric Products Inc., Salem, Mass.



INSTALLATION AT GLENVIEW GOLF CLUB, GOLF, ILL.

Lighting a Curling Rink

LIGHTING OBJECTIVE: To illuminate two curling rink courts.

GENERAL INFORMATION: Each curling court is 14 feet wide and 146 feet long. The ceiling of this building is 12 feet high at the sides and 17 feet high at the center. The light brown wooden upper walls and ceiling have a 30 per cent reflectance; the lower walls are light gray, 35 per cent reflectance. The reflectance of the white floor with a new layer of ice is 40 per cent, and the red circles in the goal area have 10 per cent reflectance.

INSTALLATION: Each court is illuminated by a total of fourteen Curtis No. N-40603 luminaires with 35-degree crosswise shielding and 25-degree lengthwise shielding. Twelve units are spaced on 12-foot 8-inch centers, lengthwise of the rink, and approximately 12 feet above the playing surface. Two units are used side-by-side over each goal area. Each luminaire uses two 105-watt 96-inch T-12 rapid start fluorescent lamps.

After approximately 500 burning hours, the average illumination on the general contest section was 25 footcandles, with 40 footcandles at the goal areas. Floor brightness varies from 10 footlamberts in the general contest area to about 15 footlamberts in the goal areas. Luminaire brightness values are: 45 degrees crosswise, 1370 fL; 45 degrees lengthwise, 1460 fL.

Lighting designed by Lester B. Knight & Associates, Chicago; installed by Brod Electric Co., Skokie, Ill.

Lighting data submitted by W. H. Zuehsow, Curtis Lighting, Inc., Chicago, as an illustration of good lighting practice and to aid in the design of similar installations.

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Circuits for Short-Arc Lamps

By THEODORE C. RETZER

In recent years, the development of high pressure short-arc mercury lamps has necessitated the design and development of special circuits for proper operation of these lamps. Like most vapor discharge lamps, short-arc mercury lamps require auxiliary devices to initiate the arc and limit the lamp current to design values. The characteristics of short-arc mercury lamps and their application requirements have imposed some interesting circuit design problems.

Applications of short-arc mercury lamps fall into two categories, namely, commercial and military. The majority of commercial applications permit a lamp warm-up of several minutes to full brilliance. In case of a power failure, five to ten minutes can elapse before the lamp is reignited and reaches full light output. In most military and some commercial applications, some light is required immediately, followed by a fast lamp warm-up, which can be accomplished by using lamps of the mercury-xenon type. Assuming proper lamp design, instantaneous starting or reignition, in case of a power failure, is possible with a circuit designed to produce transient characteristics which permit starting under any lamp pressure and temperature. The circuits described herein are designed for the operation of short-arc lamps on 60-cycle alternating current power of 110-125 volts, which is the primary supply used for these lamps in the United States today. However, the high-voltage pulse starting circuit will readily fulfill any lamp starting requirement on direct current, using a resistive ballast to limit lamp current.

Short-Arc Lamp Types

Short-arc mercury lamps like the SAH-250-A shown in Fig. 1 have a single-ended current carrying leads construction and outer bulb. These lamps are filled at low pressure with an ionizable gas, such as argon. They must be at room temperature when started, so that the temperature and pressure within the lamp is low enough to permit a starting voltage of a few hundred volts to break down the gap between the electrodes. A properly designed starting circuit must develop not more than 400 volts to prevent damage to the lamp or socket, if, following a power interruption, attempts are made to restart the lamp before it has cooled sufficiently.

Lamp construction with diametrically opposite current carrying leads permits the use of high-voltage pulse circuits for starting and restarting after a power failure. Short-arc mercury lamps like the SAH-1000-A shown in Fig. 1 can therefore be restarted when hot. Other lamps having this double-ended construction are mercury-xenon and xenon short-arc lamps, which are generally filled to one or more atmospheres of xenon gas. They require high-voltage pulse circuits for starting at any temperature.

Lamp and Circuit Electrical Characteristics

The design of short-arc lamp circuits requires that proper consideration be given to the electrical characteristics of the lamp in order to ensure satisfactory lamp performance. An inductance or resistance of suitable rating to match lamp and line voltage characteristics can be used to control the current through the lamp. An inductive ballast is

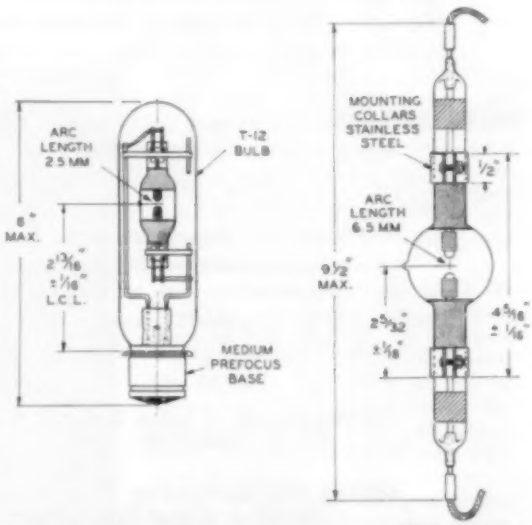

Figure 1. Two types of short-arc mercury lamps. (left) 250-watt lamp with single-ended current carrying leads, (right) 1000-watt lamp with diametrically opposite current carrying leads.

A paper presented at the National Technical Conference of the Illuminating Engineering Society, August 17-22, 1958, Toronto, Ont.
Author: Lamp Division, Westinghouse Electric Corp., Bloomfield, N. J.

generally preferred because of higher efficiency. A resistance ballast may be suitable in experimental circuits.

Inductive ballasts are usually designed to provide a lamp starting current of one and one-half to two times the lamp equilibrium operating current in order to keep warm-up time to a minimum. Short-arc mercury lamps are generally designed with arc voltages of 60 to 75 volts, for most efficient operation on a 110-125-volt line. At this primary voltage, lamps will have a tendency to extinguish if the arc voltage exceeds 80 volts, because the reignition voltage is too high for the applied voltage.

Operation of short-arc lamps with an inductive ballast from a 115-volt power source is preferred over operation from a 220-volt line due to the difference in ballast power loss and because of the better inherent lamp starting current characteristics obtained. The lamp arc voltage and the voltage across an inductive ballast are vector quantities, and it is apparent from the shape of the curves shown in Fig. 2 that higher lamp starting currents can be obtained with ballasts designed for a 115-volt line than for a 220-volt line. The values given are for lamps having initial starting arc voltages of 10-20 volts and equilibrium arc voltages of 60-75 volts.

It is desirable that the lamp operating current value be on the linear portion of the inductive voltage-current curve, so that lamp wattage will be least affected by fluctuations in line voltage. For best performance, a voltage regulator should be provided if the lamp wattage varies more than 7½ per cent from the nominal rating due to variations in line voltage. Series inductive ballasts should have voltage taps in 5-volt steps for operation from a 110-125-volt line.

Lamp Starting Requirements

To state it in simple terms, in order to get a short-arc lamp to start and continue to operate, the voltage drop across the lamp must decrease enough so that the applied line voltage is sufficient for the lamp arc to be self-maintaining. It is not simple to accomplish this under certain conditions. With short-arc lamps, the problem resolves itself into designing starting circuits which will provide the means of getting the tungsten electrodes hot enough so that they become good thermionic emitters. Whenever this condition is reached, the reignition voltage needs to be only slightly higher than the arc voltage for the lamp to be self-maintaining.

As shown in Fig. 3, lamp current starts to flow each half cycle when the voltage reaches the reignition voltage. Current continues to flow until the extinguishing point at the latter part of the half cycle, at which time the line voltage falls below the arc voltage. This is repeated every half cycle. If higher open-circuit voltage is used, other circuit constants remaining the same, the lamps will start more easily, because the voltage will rise more rapidly, and the reignition voltage will be reached earlier in the half cycle. Lamp current will start to flow earlier in the half cycle and will last for a larger portion of the cycle because the point at which the circuit voltage falls below the arc voltage

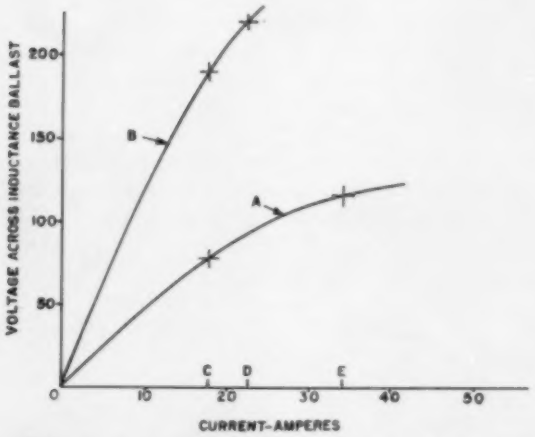

Figure 2. Voltage-current characteristics of inductance ballasts for 1000-watt short-arc mercury lamps. Curve A is for 115-volt line. Curve B is for 220-volt line. Point C is lamp operating current for curves A and B. Point D is lamp starting current for curve B. Point E is lamp starting current for curve A.

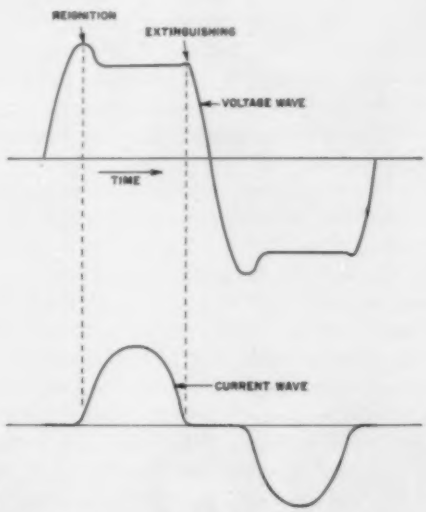

Figure 3. Short-arc lamp voltage and current waves under operating conditions.

will occur later. This explains why lamps will start more easily at a line voltage of 115-125 volts than at 105-110 volts.

Starting Circuits for Low-Pressure Short-Arc Mercury Lamps

Low pressure short-arc mercury lamps having single-ended construction for the current carrying leads, such as the SAH-250-A lamp, can only be started cold. The circuit shown in Fig. 4 develops a starting voltage of 250-300 volts, and will satisfactorily start a cold low-pressure lamp of proper design in less than three seconds. If one attempts to start a hot lamp on this circuit, the voltage is not sufficient to cause arc-over in the outer bulb or socket. However, the lamp will not start until it has cooled sufficiently to permit 250-300 volts to start it.

With reference to the circuit component designations of Fig. 4, the circuit functions as follows: The inductive ballast has voltage taps and voltage-current characteristics to control the lamp within specified wattage when operated from a 110-125-volt line. The booster transformer T_1 is an isolation transformer of approximately 1:1 ratio, having low reactance when the primary voltage is applied. Push button switches S_1, S_2, and S_3 are a common switch, in which S_1 and S_2 are normally open and S_3 is normally closed. To start the lamp the button is pushed, opening S_3 and closing S_1 and S_2.

During the time the push button is held down, the booster transformer T_1 adds to the line voltage. The voltage appearing across the lamp socket will be the vector sum of the voltages across resistor R and capacitor C. Proper selection of the values for transformer T_1, resistor R, and capacitor C permits any breakdown voltage required by the lamp design, up to 400 volts. Resistor R and capacitor C are normally selected to give starting surge currents of two to three times the lamp operating current. Assuming correct component constants, the developed voltage will be sufficient to cause breakdown across the lamp electrodes. Upon voltage breakdown, the charge in capacitor C will discharge through the lamp. If the current does not continue to flow through the lamp, the capacitor C will repeatedly recharge and then discharge through the lamp until current flows continuously, at which time the lamp electrodes will be at thermionic emitting temperatures. At this electrode temperature the lamp will continue to operate after the starting push button is released. When the push button is released S_1 and S_2 open, and S_3 closes and shorts out the secondary winding of booster transformer T_1. The contacts of S_3 must be capable of carrying the lamp current.

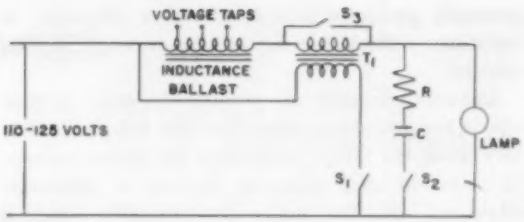

Figure 4. Starting and operating circuit for short-arc mercury lamps having single-ended current carrying leads.

Starting Circuit for High Pressure Lamps

The circuit used to start short-arc lamps having diametrically opposite current carrying leads, under any pressure and temperature condition is shown in Fig. 5. It consists essentially of a spark gap oscillator feeding a pulse transformer which delivers approximately 50,000 volts to the lamp. However, it is essential that the design of the starting circuit components permit the spark gap oscillator to deliver 10 to 20 pulses per half cycle of the 60-cycle voltage wave. The starting circuit must first develop sufficient voltage to break down the discharge between the lamp electrodes. The high voltage must have several pulses which occur at a time corresponding to the interval between the reignition and extinguishing point of the 60-cycle wave. The high-voltage pulses occurring during this time interval result in 60-cycle current flow which heats the lamp electrodes to thermionic emitting temperature, and the lamp becomes self-maintaining on the applied line voltage. From a practical standpoint, it has been found that a voltage of 50,000 volts having 10 to 20 pulses per half cycle is needed. Experience has shown that proper circuit component design requires that the high-voltage pulse be applied not more than three seconds for satisfactory lamp starting on a 115-volt line. This is important because prolonged use of high voltage results in premature darkening of the lamp bulb due to positive ion bombardment of the tungsten electrodes. Tests have shown that a good

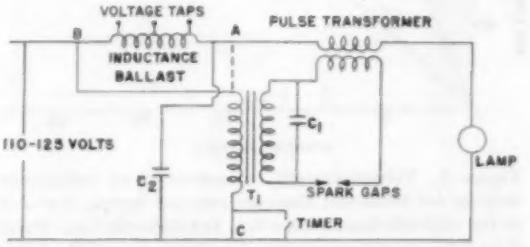

Figure 5. Starting and operating circuit for high pressure short-arc lamps.

lamp can become very black within approximately 30 minutes with continuous use of high voltage having insufficient pulses to permit the lamp to start.

With reference to Fig. 5, the operation of the starting circuit consists of charging capacitor C_1 from transformer T_1 and discharging it through the pulse transformer and the spark gaps, which, preferably, are two or three air spark gaps in series to minimize the effect of ionization of air between the gaps. For given circuit components, the magnitude and quantity of high voltage pulses developed depend on the spark gap spacing. Wide spark gap spacing develops more voltage but fewer pulses per half cycle than close gap spacing. A given circuit provides optimum starting ability when the spark gaps are adjusted to the minimum spacing which will still develop sufficient voltage to break down the arc discharge. At this spacing, a maximum number of high-voltage pulses will be produced for a minimum breakdown voltage. Capacitor C_2 is used to prevent high-voltage pulses feeding back into the supply line.

Some short-arc lamp applications require automatic starting circuit operation, where the supply voltage is automatically furnished at a chosen time by means of a time clock. The starting circuit shown in Fig. 5 will function automatically from the supply voltage when the primary of T_1 is connected directly to points A and C. With this connection, the spark gaps are adjusted to break down at a line voltage of approximately 90 volts, and not to break down below this value. The voltage between points A and C is approximately equal to the voltage across the lamp, since the voltage drop across the pulse transformer will be only one or two volts with a properly designed transformer. The lamp voltage under operating conditions is less than 75 volts. This means that the starting circuit will not function during lamp operation, but will immediately start to function as soon as the lamp goes out. However, this circuit connection has several inherent bad features, and its use is not recommended. First, if the lamp becomes inoperative during life, the circuit will continue to function until the line voltage is removed. Second, normal variations of the circuit components due to manufacturing tolerances require that the spark gap spacing of each unit be accurately adjusted to function above 90 volts line, and not below this value. This critical adjustment of the spark gaps is usually not the correct spacing for optimum lamp starting ability of the given circuit components. With this circuit arrangement, it will be found that frequently lamps will go on and off several times before the lamp electrodes have heated sufficiently for the lamp to stay lit on the supply voltage.

For automatic operation the preferred connection of the primary winding of transformer T_1 is point B as shown in Fig. 5. Reliable lamp starting performance can be obtained with a timer to open the primary of transformer T_1 five seconds after the supply voltage is applied. If the power is interrupted, the timer again energizes T_1 for five seconds when the power is resumed. The reason five-second timers are used with automatic circuits designed to start lamps in less than three seconds is to assure that the lamp electrodes have heated sufficiently for the lamp to stay lit. This has proven reliable in existing installations requiring automatic operation.

Cold Lamp Starting *Vs.* Hot Lamp Starting

At room temperature, high-pressure mercury-xenon or xenon short-arc lamps can be started within three seconds with approximately 12,000 volts having 5 to 10 high voltage pulses per half cycle, while short-arc mercury lamps, having double ended construction, can be started with approximately 1000 volts having 5 to 10 voltage pulses per half cycle. This is easily accomplished with proper circuit component design and spark gap adjustment, with transformer T_1 connected at point B in Fig. 5. However, at the most difficult time of lamp starting, approximately 50,000 volts with 10 to 20 high voltage pulses per half cycle are needed. The most difficult time is following a power interruption and after the lamp electrodes are cooled just below the visible red, when the lamp is still hot and near operating temperature and pressure. This condition is frequently referred to as a "hot start" requirement of a starting circuit. The starting circuit characteristics required to reignite a lamp under the "hot start" condition necessitate critical adjustment of the spark gap spacing.

Close manufacturing tolerances of the circuit components are also necessary, because as the spark

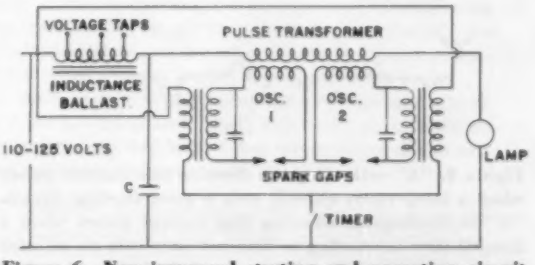

Figure 6. New improved starting and operating circuit for high pressure short-arc lamps.

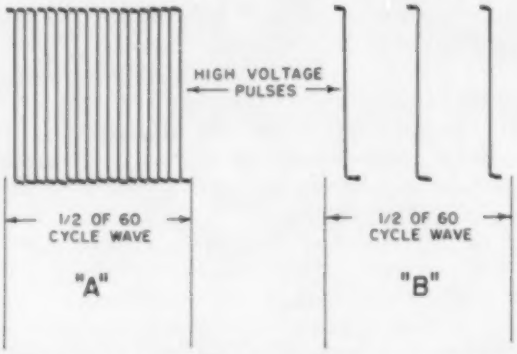

Figure 7. "A" — Oscillogram from a good starting circuit contains 15 to 20 high voltage pulses each half of 60-cycle wave. "B" — Oscillogram from an inferior starting circuit contains 2 to 4 high voltage pulses each half of 60-cycle wave.

gap spacing is increased to develop more voltage the number of pulses produced is substantially reduced.

A new circuit has been developed for "hot starting" which does not have the critical features of the circuit shown in Fig. 5. This circuit is shown in Fig. 6. It consists of a pulse transformer having a double primary winding with two separate spark gap oscillator circuits. This circuit with less critical manufacturing tolerance of the circuit components permits spark gap spacing to give the required 50,000 volts with a large number of pulses. For example, spark gap spacing of oscillator #1 can be adjusted to produce 50,000 volts having 3 to 8 pulses per half cycle. Oscillator #2 can be adjusted to produce 10,000 to 15,000 volts having 12 to 20 pulses per half cycle. This combination eliminates the undesirable feature of the circuit in Fig. 5, in which the wide spacing of the spark gaps required to develop 50,000 volts for "hot start" of lamps also decreases the number of pulses.

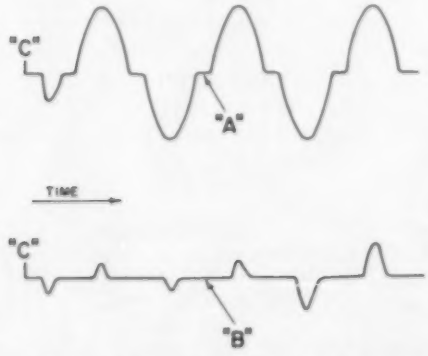

Figure 8. "A" — Oscillogram showing line current pulses when a lamp starts quickly with a good starting circuit. "B" — Oscillogram showing line current pulses when a lamp is slow in starting or does not start with an inferior starting circuit. "C" — Time of switch closing when line voltage is applied.

Measurements of Starting Circuit Parameters

A method has been established for predicting the reliability of performance of starting circuits, and for differentiating a good circuit from an inadequate circuit. The voltage developed by the starting circuit is measured, using a sphere gap voltmeter, across the output of the pulse transformer. The number of high voltage pulses per half cycle produced by a starting circuit can be photographed from a single sweep on an oscilloscope with a probe located approximately one inch from the pulse transformer primary winding. Fig. 7 shows the relative number of pulses obtained from a good starting circuit and from an inferior circuit. Fig. 8 shows oscillograms of line current pulses when a lamp starts quickly from a good circuit, and when a lamp is slow to start or does not start from an inferior circuit. Curve "A" shows full lamp current is quickly attained from a good starting circuit after line voltage is applied, whereas, curve "B" shows insufficient lamp current from an inferior starting circuit after line voltage is applied.

Conclusion

A new means of predicting reliability of performance of a starting circuit has been established, and a new circuit which overcomes critical features of previous circuits has been developed. Short-arc type lamps are still in their infancy and applications are continuously being found where they can be used to advantage. Undoubtedly, as in the past, future short-arc lamp designs and applications will result in the design of new circuits to fulfill these requirements.

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DISCUSSION

L. F. BIRD:* We are pleased to see a paper on circuits used on power supplies for compact arc lamps. The usefulness of this type of lamp has earned it an increasing place in various applications.

We are presenting some additional information, supplementary to this paper, which we believe will add to the general knowledge and be useful to any who are working in this field.

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Our first comment concerns itself with the ballasts described on the second page. The kind of ballast used with the arc lamps has a considerable effect upon the performance of the lamps. It is possible to operate them using resistances, inductances or capacitors. The inductances are classified into several groups by the details of their construction. Oscillographic pictures of the currents through the lamps disclose wide varintions in the current wave shape when operating from the different types of ballasts.

Mr. Retzer has described a particular kind of inductive ballast, one that is current sensitive. The current wave portrayed shows the current in the form of pulses with low flat places in between. This inductance was constructed with an iron core designed to be highly saturated during a large portion of each cycle. While in the saturated condition, the inductance is much reduced. Since the saturation occurs at the same time that the line voltage is at a maximum, the current assumes the form shown. If the construction were such that the inductance were unaffected by currents through it, the lamp current would have a different pattern.

It is quite often desirable to control the shape of the light pattern given out by the lamp. Wide variations are possible. We have investigated operation on direct current, low and high audio frequency alternating currents, and with specialized ballasts which were designed to produce specially shaped pulses of light.

As in other high pressure mercury vapor sources operated from alternating current, the light output from compact arc lamps varies cyclically between a maximum and a minimum value. For instance, with a 60-cycle supply, the light comes out in pulses of 120 cps and there is a residual light of about 10 per cent of the peak value at all times. The light does not go out completely between cycles. As the frequency of the supply is increased, the amount of residual light is increased until at 10,000 cps the modulation of the light is almost eliminated, and the light is steady as if the supply were direct current. Intermediate frequencies indicate varying amounts of steady light with changing modulation conditions. The shape of the modulation can be essentially sine wave.

Mercury arcs are well-known for their negative volt-ampere characteristics which make them the unstable members of the electrical family. It is a necessity for a stable system that the total circuit volt amperes be positive so that an increase in voltage brings an increase in current. The arcs, therefore, have to have ballasts that will correct the total circuit. The voltage across the arc cannot represent too great a portion of the supply voltage or the necessary conditions cannot be met.

There is a definite advantage to be gained by having the lamp voltage about 60 per cent of the supply voltage because of the effect of the lamp operating voltage on the lamp wattage. Within a range of about plus or minus 10 per cent in lamp voltage, the wattage consumption can be almost constant. This feature is of definite advantage.

Our experience with starting lamps indicates the possibility of starting a lamp with essentially cold electrodes, since an arc can be established within a few cycles from a cold start, and this time does not permit much warm-up of the electrodes. We have found compact arc lamps of the larger sizes hard to light if the supply voltage is below 100 volts for either direct or alternating currents. All lamps light more readily on direct current or higher supply frequencies. Lamps are more easily started on 400-cycle current than on 60-cycle.

We have had considerable experience with the ignition systems pictured in Fig. 5 and have the following comments about them.

It is our understanding that for good lighting conditions the radio-frequency power developed in the oscillator should be completely absorbed by the gas in the lamp during the initial pulse, allowing no power to continue the oscillation. The oscillation is completely suppressed. The highly damped type of oscillator provides the best conditions for this kind of performance. The number of sparks produced by the spark gap per half cycle is somewhat dependent upon the ability of the transformer core iron to magnetize and demagnetize, but it is more the function of the open circuit voltage of the transformer. A high voltage transformer will give more sparks than a low voltage one, assuming other conditions to be the same.

E. Boghosian:* To my knowledge this is the first published paper to describe in detail what is actually taking place in the starting circuit during starting. It is assumed that the author intends to imply that the voltage pulses per half cycle from the two oscillators shown in Fig. 6 are additive. An explanation of how the outputs of these oscillators are combined would be helpful.

B. R. Finch:** We have manufactured a number of starters for short-arc lamps and have always employed a single primary winding on the pulse transformer, together with a single spark gap oscillator circuit. We have experienced no difficulty starting hot or cold lamps on this circuit. In view of the fact that we have not heard of any difficulty encountered with these circuits, we wonder if it would be wise to change to the more complicated and costly circuit described in this paper.

R. E. Farnham:† Following his general discussion of the two types of short-arc lamps, Mr. Retzer discusses their operation on 115-volt lines as compared to 220 volts using inductive ballasts. The impression is created that operation from 220-volt lines is to be avoided. However, a simple auto transformer of the high reactance type, with connection to the lamp such as to provide the requisite arc striking voltage, permits operation on 220-volt lines with volt-ampere characteristics equal to those obtainable with 115-volt lines.

Reference is made in several instances to the necessity of the pulse oscillator delivering 10 to 20 pulses per half cycle. Has an investigation been made as to other pulse frequencies? Does this 10 to 20 figure represent a critical quantity? We have found that the size of capacitor C1 (Fig. 5) as well as the design of the gap is quite important in the generation of pulses containing sufficient energy to bring the electrodes to a proper emission temperature.

In connection with his work on low pressure lamps, I wonder if Mr. Retzer has encountered any difficulty with lamps rectifying because one electrode has reached the proper temperature and the other is still at too low a temperature when transfer to full line operation is made.

It would seem that the rather complex arrangements of Fig. 6 for providing both "cold" and "hot" starts could be considerably simplified by omitting one oscillator circuit and merely switching from one spark gap to another.

T. C. Retzer:†† The comments of the several discussers are greatly appreciated and their interest is especially encourag-

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†General Electric Co., Cleveland, Ohio.
††Author.

ing since short-arc lamps are not as well known or yet as widely-used commercially as some other light sources.

The additional information supplied by Mr. Bird on general knowledge of short-arc lamp circuits may be useful to persons working in this field. My only comment on this information is that we found that the radio frequency had little effect on lamp starting. This was tested by bypassing the radio frequency energy developed from the pulse transformer.

In regard to Mr. Boghosian's comment pertaining to the two oscillators in the new starting circuit shown in Fig. 6, each oscillator circuit has separate primaries and the voltage pulses from the two oscillators combine, since each oscillator circuit is connected to the same pulse transformer through separate pulse transformer primary windings. Each oscillator operates independently of the other and the number of pulses produced by a given oscillator circuit depends on the spark gap spacing and circuit constants of the given oscillator circuit. The total number of high voltage pulses produced each half cycle by the pulse transformer is the sum of the number of pulses produced from both oscillator circuits.

Mr. Finch is correct in assuming that a single oscillator circuit having circuit components of proper design and accurately adjusted spark gaps will start a short-arc lamp either hot or cold. However, it has been our experience with a single oscillator circuit that the air spark gaps must be kept clean and critically adjusted within a few thousandths of an inch, in order to develop the necessary voltage and number of pulses to restart a lamp under the most severe lamp starting conditions. As mentioned in the paper, following a power interruption the most difficult lamp starting condition is when the lamp is near full operating pressure and the electrodes are below visible red temperature. This is after one to two minutes following a power interruption, depending on the lamp design. In service, the air spark gaps oxidize during use and become effectively wider until the single oscillator circuit does not develop enough pulses to restart the lamp.

Where a high degree of reliability of starting performance is required, the additional cost of the dual oscillator circuit may be justified. The dual oscillator circuit permits less critical adjustment of the spark gaps, and because the spark gap adjustment is less critical, the spark gap adjustment maintenance is less. The dual oscillator circuit was developed because of close manufacturing tolerances required of the circuit components of the single oscillator circuit, in order to obtain a sufficient number of pulses when the air spark gaps are opened wide enough for the circuit to develop enough voltage to break down the discharge, when an attempt is made to restart a lamp under the most severe starting conditions.

I will discuss the several comments of Mr. Farnham in the order presented. Using a series inductance ballast, 115-volt operation was chosen over 220-volt operation because of equipment cost, high lamp starting current and, consequently, faster lamp warm-up. A more complex circuit would be required for a 220-volt operation to obtain lamp starting current equal to that obtained on 115-volt operation with a series inductance ballast. The use of an auto-transformer to permit operation on 220-volt line would be more expensive than a series inductance ballast on a 115-volt line, and since it would have to carry full lamp current, the kva transformer rating would be high in proportion to a given wattage lamp.

Extensive tests with many lamps showed that 10 to 20 high voltage pulses per half cycle gave a sufficient number of pulses between the ignition or reignition point and the extinction point of the voltage wave to permit lamp current to flow and provide reliable lamp starting under various lamp temperature and pressure conditions for existing lamp designs. Our tests showed that less pulses would not reliably restart lamps under the most severe lamp starting conditions. We have tested up to about 50 pulses per half cycle and values from 10 to 50 gave satisfactory results.

It is true that the size of the capacitor and air gap design are important for the generation of pulses. Even more important are the transformer designs. The paper defined the performance requirements of the circuits and how to measure the circuit characteristics for proper evaluation of a starting circuit. No attempt was made to present the design characteristics of the circuit components, since this would require another full length paper.

We have observed no difficulty with low pressure lamps rectifying when the transfer is made to full line operation.

Considering the number of pulses required per half cycle from a 60-cycle source, it is my opinion that the suggestion of using one oscillator circuit and switching from one spark gap to another would be more complex and costly than the dual oscillator circuit shown in Fig. 6.

Applications for Retired Membership

By action of the membership of IES, retired membership classifications are available to those members qualified. Privileges in these grades, earned by long membership in the Society, include reduced annual dues ($5.00) with the continued receipt of all Society mailings, including ILLUMINATING ENGINEERING. Classifications are known as Member, Retired; Fellow, Retired; Associate Member, Retired.

Those who are interested and qualified (at least thirty years of membership in the Society and 65 years of age) should communicate with the General Secretary at Society Headquarters, stating that they have retired from their regular occupation in business or profession.

INSTALLATION IN MACEDONIA, OHIO.

Lighting a Window Wall

LIGHTING OBJECTIVE: To provide supplementary general lighting and decorative accent by dramatizing a planting area in a remodeled farmhouse dining room.

GENERAL INFORMATION: The 4-foot by 14-foot area illustrated had been a pantry and storage area in this farmhouse. When the house was remodeled, one wall of this room was removed to make an alcove off the dining room. A 5-foot 9-inch by 10-foot picture window was built into the outside wall and the entire 14-foot width of the wall was draped. Stationary draperies in yellow, chartreuse and green were hung on the two feet of wall at each end, and greyed-yellow (60% reflectance) traverse draperies over the window. A planting box was built along the floor next to the window, and it was tiled, along with the floor, in grey-green and grey slate (average 20% reflectance). The slanted ceiling and walls in this area were paneled with random width boards painted white (80% reflectance).

INSTALLATION: The supporting beam and the slanted ceiling made a natural division between alcove and dining room. By framing in a 10-inch by 10-inch space below the supporting beam and leaving a 10-inch opening along its alcove side, a cove was formed. Three 4-foot fluorescent channels were placed end to end in this cavity as shown in the cross section sketch. Deluxe warm

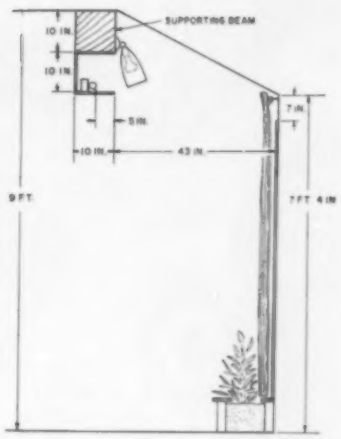
(over)

A.I.A. File No. 31

fluorescent lamps were used to blend with the incandescent lighting in the room.

The placement of the fluorescent tubes with relation to the cavity opening was governed by the fact that there is a walkway to a side entrance just outside this window wall. Placement for greatest lighting efficiency would have made the light sources visible from the alcove chairs and from outside the window. Therefore, they were placed five inches back of the cavity opening where they cannot be seen from either location.

Two 75-watt R-30 reflector spot lamps in deep bullet housings were mounted on the beam above the cove and aimed at the taller plants near the center. These add emphasis and definition to the planting area. As can be noted in the illustration, no part of this equipment is visible from the dining room. The bullet housings are deep enough so that the filament and therefore any unpleasant brightness in these clear-end bulbs is concealed from view either from the alcove or from the walkway outside the window.



Elevation of window wall.

By means of reflection from the white slanted ceiling, the illumination from the "cove" is quite evenly distributed down the draperies. The highest brightness is at the top of the slanted ceiling close to the lamps (90 to 100 footlamberts), but this part of the ceiling is not visible from the dining room. The brightness on the draperies varies from 15 footlamberts at the top to five footlamberts at the bottom. When the spots are turned on, the drapery brightness within the beam varies between 12 and 25 footlamberts. The plants do not depend on any of this light for growth, since the draperies are always kept open during the daytime.

Installation planned by R. L. Oetting, Manager, Southwestern Sales District, General Electric Co., Large Lamp Department, Dallas, Texas.

Lighting data submitted by Aileen Page, Residential Lighting Specialist, General Electric Co., Large Lamp Department, Nela Park, Cleveland, Ohio, as one solution of a lighting problem and to aid in the design of similar installations.

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Influence of Electrode Materials On Fluorescent Lamp Discoloration

By A. W. WAINIO
F. M. CRAVEN

Introduction

In the Lighting News section of the May 1938 issue of *Transactions of the Illuminating Engineering Society*, mention was made of a recently announced line of fluorescent lumiline lamps. Four lamp types were announced — the 15T8, 15T12, 20T12 and 30T8 types — each in white, daylight and five other colors. The announced efficiency for the 30T8 in white was 35 lumens per watt. It was felt that lumen values should not fall below 70 per cent of initial at rated lamp life of 1000 hours.

At the National Convention of the Illuminating Engineering Society held in August 1938, two papers were presented on fluorescent lamps. These were the first papers published by the Illuminating Engineering Society in which fluorescent lamps were treated as commercial light sources rather than as laboratory developments.

In the twenty years since then, the development, improvement, acceptance and application of fluorescent lamps has proceeded at a rapid rate and information published on fluorescent lamp characteristics has kept pace. Today the bibliography is quite extensive on factors affecting fluorescent lamp design and application such as light output and maintenance, lamp life, color, circuitry, luminaire design and lamp appearance.

For a few years after the fluorescent lamp was introduced, maintenance of a clean, uniform lamp appearance was considered a problem somewhat secondary to other unsolved problems confronting the lamp design engineer. Increasing attention has been given this problem, as reported previously.[1] In this paper, the authors hope to contribute to the fund of knowledge by presenting data on the role of electrode materials in minimizing end discoloration.

End Discoloration

The discoloration of fluorescent lamps which occurs near the ends is an appearance condition easily observed by the user. It is one of the few quality items which requires no instrumentation for evaluation. The degree to which discoloration is considered objectionable by the user depends primarily on application factors which determine whether or not the discoloration is readily apparent.

Deposits on the inner wall of the lamp which cause end discoloration may be classified according to appearance and location on the lamp. For the purpose of this discussion, the deposits are classified as end bands, diffused spots and spots. Deposits thus classified are illustrated in Fig. 1, which shows progressive development of the deposits during lamp operation.

End bands are ring-like deposits around the circumference of the lamp, having a rather sharply defined edge toward the cathode and tapering off in density in the direction of the opposite lamp end. The deposit is composed of mercury associated with oxides of mercury. Oxygen or gaseous oxygen compounds residual in the lamp or evolved during lamp operation reacts with mercury ions to form the deposit. The time and rate of occurrence depend on the availability of oxygen or gaseous oxygen compounds.

Diffused spots are areas of discoloration of low density in the vicinity of the cathode. The deposit is generally found to be a light deposit of metal from the electrode structure supporting the cathode. (The term "electrode" as generally used in-

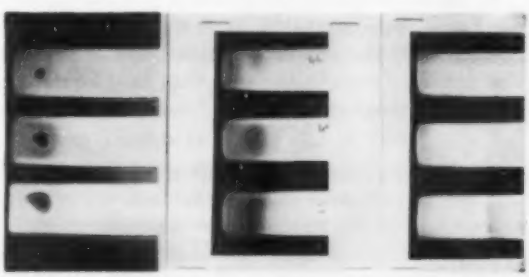

Figure 1. Types of fluorescent lamp discoloration. Deposits are classified as spots, diffuse spots and end bands.

A paper presented at the National Technical Conference of the Illuminating Engineering Society, August 17-22, 1958, Toronto, Ont.
AUTHORS: Lamp Division, Westinghouse Electric Corp., Bloomfield, N. J. This paper accepted by the Papers Committee of I.E.S. as a Transaction of the Illuminating Engineering Society.

cludes the cathode and associated support structure such as lead wires and anodes. In this paper, the term is restricted to indicate the lead wires and other metal components excluding the coated cathode.) The most probable explanation for the transport of the metal from the electrodes to the bulb wall is that the metal is sputtered as atoms by mercury ions accelerated by the high cathode drop accompanying poisoned cathode emission or cathode deactivation near end of lamp life. This type of deposit occurs most frequently late in lamp life, but can occur at any time when, for some reason, a high cathode drop exists.

Spots are dark, sharply defined areas in the vicinity of the cathodes which are caused by deposits of electrode metal, mercury and barium. Barium as used in this paper also includes strontium and calcium which are present in the cathode emission coating. The presence of mercury can be detected in most cases by examination of the deposit under a microscope. When the spot is gently heated in air or vacuum, the opacity of the spot is reduced as the mercury is evaporated. Mercury has a strong affinity for barium, forming with it a liquid metallic solution or amalgam. Mercury may also amalgamate with metal deposited from the electrodes, depending on the metal. An amalgam will be formed with nickel and iron, but only to a negligible extent with tungsten.[2] At the relatively low bulb temperatures encountered in fluorescent lamps, the concentration of mercury in mercury amalgams is such that a very opaque deposit results from only a thin film of amalgam.

Table I presents data based on spectrographic analysis of materials present in spots developed in four 40-watt T12 fluorescent lamps in which nickel was the electrode material. Care was taken not to disturb the pattern of mercury deposit. Three areas were analyzed — the spots, the area immediately surrounding the spots, and an area in mid-length of the lamps. The data for the lamps were practically identical. The amounts present are expressed as rough approximations of the number of atomic layers of the element in the deposit.

It can be seen that the amounts of mercury and barium in and near the spot were considerably greater than the amount of nickel. More of each element was found in the spot than in the vicinity, with the greatest difference found for mercury.

TABLE I — Relative Amounts of Materials in Spots (Number of Atomic Layers).

Location	Mercury	Barium	Nickel
Spot	75	26	3
Area around spot	8	11	1
Area in mid-length	1		

This evidence is interpreted as confirmation that mercury concentration is largely responsible for the opacity of the spot.

Mechanism of Spot Formation

The formation of spots has usually been explained on the basis of mercury combining with metallic barium released from the cathode. The primary processes by which barium is released are thermal evaporation, sputtering by mercury ions and electron bombardment.

An activated oxide cathode contains free barium distributed throughout the oxide coating. As the temperature of an activated cathode is raised, the free barium will evaporate, the rate accelerating with temperature. In lamp manufacture, the activation processes must be carefully controlled or an excess of free barium will be created which will be available to contribute to early lamp discoloration.

If the cathode emission is poor, a high cathode drop will result and mercury ions will be propelled into the cathode at energies sufficient to sputter off, not only the free barium normally present in small concentrations in an activated cathode, but also the oxide coating. The free barium thus sputtered will contribute to lamp discoloration. Even with well activated cathodes, the process occurs to a small degree, being effectively controlled by the presence of the inert gas filling without which cathode life would be materially shortened.

In a fluorescent lamp properly processed and operating on correct auxiliaries, a slow loss of emission material occurs through decomposition of the oxides by electron bombardment. Electron bombardment on the anode half-cycle normally contributes to the energy required to maintain a cathode at proper emitting temperature and is a consideration in cathode design. It has been shown[3] that at bombarding energies near four electron-volts, decomposition of barium oxide sets in. Other studies reveal that such energies are attained in the mercury discharge in the vicinity of the cathodes. In another investigation,[4] it was concluded on the basis of spectroscopic analysis that dissociation of the oxide layer (of BaO-SrO type cathode) by electron bombardment occurs as well as simultaneous vaporization of excess strontium atoms with barium atoms from the surface layer. The release of barium by this process seems well established.

Barium released by the above processes and diffusing as atoms through the fill gas would be expected to produce deposits of lower density and greater area in contrast to the dense, sharply-defined spot discoloration. Spectroscopic studies of the discharge in the vicinity of the cathodes, made in our laboratories and elsewhere,[4] have disclosed

barium arc and spark lines. Probe measurements indicated that barium ions should be attracted back to the negative lamp electrode and repelled to the walls by the positive lamp electrode as the lamp operates on alternating current. Experiments with barium evaporated into the discharge show that this is the case. It is fairly certain that part of the released barium becomes charged and hence, the amount and location of the barium deposit on the bulb wall is influenced by the electric field at the electrode-cathode structure.

The theory that released metallic barium, concentrated at certain bulb wall locations by the electrode field, combines with mercury to form spots does not adequately explain certain observations made in studies of lamp discoloration. Spots do not always occur in lamps in which metallic barium is released. Analyses of spots always indicate the presence of lead wire material in addition to mercury and barium. Use of different electrode materials results in widely different frequency and severity of spot formation in lamps otherwise identical in design and processing. It appears that a new theory is required which will include the effect of lead wire materials.

The following mechanism is believed to offer a more adequate explanation of the effects observed: Barium released from the cathode and depositing on the bulb wall ordinarily combines with gaseous impurities present in the fill gas or on the phosphor surface, resulting in a deposit causing no noticeable discoloration. The nucleus of spot formation is an amalgam of mercury and material sputtered from the lead wires or from other metallic electrode elements electrically connected to the cathode and relatively close to it. As this amalgam grows in size, barium is deposited on it and becomes a part of the amalgam. With barium present, the mercury concentration increases, due to the strong affinity of mercury for barium, and a dense spot results.

Electrode Sputtering

According to the above theory, sputtering characteristics of electrode materials will have a great effect on spot formation in fluorescent lamps. A series of tests was made to determine the relative resistance of electrode materials to sputtering as a prelude to running lamp tests with selected electrode materials. The lead wire material most commonly used to support the cathode and to provide anode area, if desired, is nickel or nickel-plated iron. It was quickly determined that relative to other materials tested these materials are easily sputtered.

Fig. 2 illustrates the deposits obtained by sputtering lead wire materials under certain conditions. The four tubes pictured all had nickel lead wires on one end and black plated iron, iron, zirconium or tantalum at the other end, as shown. The tubes had no tungsten coils and contained mercury and two millimeters of argon. The lead wire conformations were roughly similar to those used in lamps. The tubes were connected in series and glowed at five milliamperes for three minutes, producing the sputtered deposits as pictured. While this test cannot be considered a measure of sputtering rates of the materials, it does illustrate relative resistance of materials to sputtering at a glow current which can occur in fluorescent lamps.[5] The superiority of certain lead wire materials over nickel, relative to sputtering, as illustrated in Fig. 2, was confirmed by other tests and led to the conclusion that use of a material other than nickel (or nickel-plated iron) would result in reduction of spot formation in lamps.

Figure 2. Sputtering of nickel and other materials. These tubes were sputtered by a 5-milliampere current in mercury vapor and two millimeters of argon.

It was observed that deposits formed by sputtering in glow tests, such as described above, followed the expected diffuse pattern, whereas similar tests in lamps with activated cathodes produced sharply defined deposits similar to spots in density and location. The pattern of the deposit could be altered by changing the geometry of the leads and coil structure, leading to the conclusion that the resulting electric field determines the location and concentration of sputtered deposits.

Groups of fluorescent lamps were made with lead wire materials such as tantalum, zirconium, vanadium, tungsten, niobium, stainless steel and black plated iron. These lamps were processed as identically as possible and then placed on life test for observation of discoloration. The considerable variation in results observed was traced to the extent to which the lead wires became oxidized in lamp manufacturing processes. From these lamp tests it was found that vanadium, tantalum, niobium and black plated iron resulted in the cleanest lamps and

gave results superior to nickel. Some materials (such as molybdenum and iron) which showed promise on sputtering tests were not satisfactory in lamps because of end bands resulting from unstable oxides.

The choice of lead wire material for use in fluorescent lamps must be evaluated in terms of other factors in addition to the effect on lamp discoloration. The other factors include cost, availability, workability, adaptability to available equipment and chemical and mechanical stability. With these factors considered, black plated iron emerged as the material on which further testing should be concentrated.

Black Plated Iron as Electrode Material

The black plated iron material mentioned above requires further description. The term describes a high purity grade of iron processed into the desired form (such as wire suitable for use in fluorescent lamp lead wires) and then electroplated at high current density in a bath containing chromic acid and vanadium salts.[6,7] The plating, consisting of a deposit about 0.00004 inch in thickness of finely divided chromium and vanadium metals and their oxides, has good adherence, corrosion resistance and stability at elevated temperatures in high vacuum. The deposits range in color from dull black to jet black, hence the name black plated iron. The coating is electrically conductive and has good heat radiating properties.

Having shown black plated iron to have promising resistance to sputtering and to be a practical material for electrodes in fluorescent lamps, facilities were established for producing black plated iron lead wires so that large scale tests could be made. Engineering tests run on certain lamp types gave results as shown in Figs. 3 and 4. Fig. 3 shows

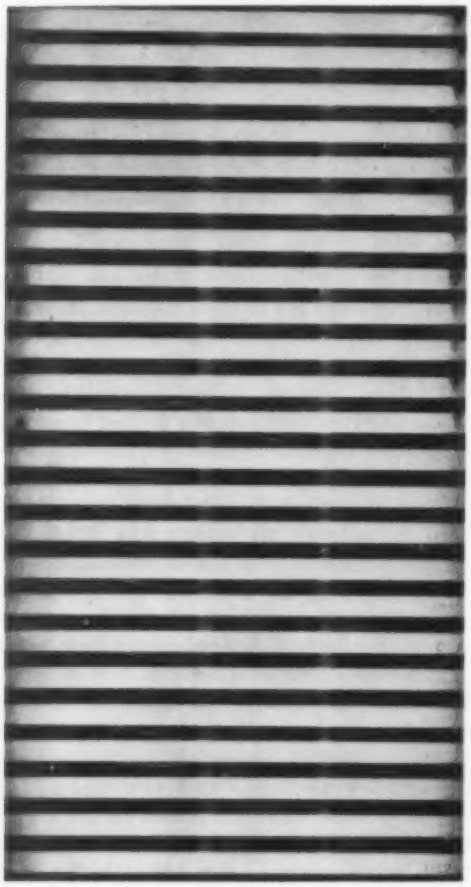

Figure 3. Comparison of nickel vs. black plated iron lead wire material in preheat T12 lamps. The spotted lamps (top twelve) have nickel leads, the rest (lower twelve) have black plated iron leads.

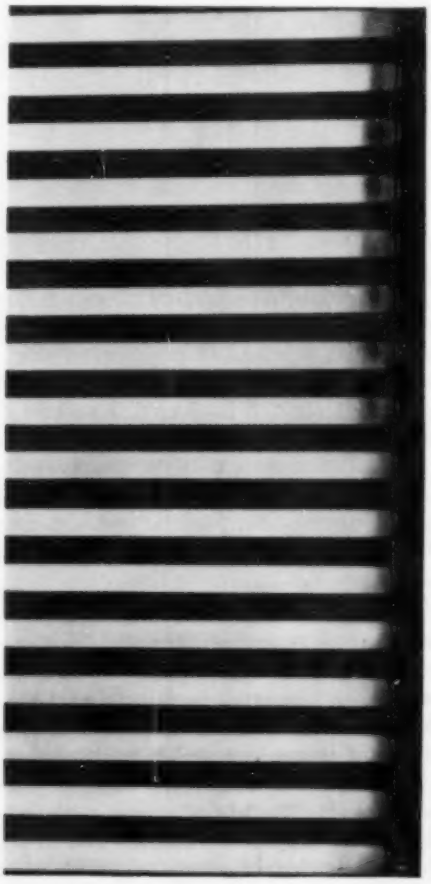

Figure 4. Comparison of nickel vs. black plated iron lead wire material in F48T12/HO lamps. The lamps with black plated iron leads (lower eight) remained much cleaner in this engineering test.

the advantage of black plated iron lead wires over nickel in preheat T12 lamps operated at 0.430 ampere for several thousand hours. In Fig. 4 the results of a comparable test on F48T12/HO lamps are shown.

Favorable engineering tests were followed by successful factory tests and finally by production use of the material. The production use has been extended, where applicable, to include other electrode components in addition to the lead wires, for example, the end chamber disks in 1.5-ampere lamps. The use of this material has proved quite advantageous in diminishing the frequency and severity of spot formation and in delaying the appearance of such spots as do occur.

The exhaust operations of fluorescent lamp manufacture must be carefully controlled to avoid conditions which tend toward formation of end bands or spots. To some extent, the process requirements for consistent avoidance of one type of discoloration are the opposite for avoidance of the other. Even though changes in cathode emission coating formulations and other improvements which provide greater latitude have been made, it is not an easy task to maintain the balance in exhaust conditions required for production of consistently clean lamps.

While the black plated iron has been successfully used in lamp types which have a tendency toward spotting, it was found that in types having a tendency to end banding, the results have not been consistently favorable in that increased end banding may result. We believe this to be caused by oxygen released from the black plated coating (the mechanism of which we are investigating) which provides some oxygen in excess of the "balanced" condition and thereby promotes end bands.

Circuit Influence on Spot Formation

The frequency and severity of spot formations in fluorescent lamps can be markedly influenced by the characteristics of operating circuits. Lowry[1] has pointed out the damaging effect, on cathode coatings, of high peak-to-r.m.s. current values, which cause a momentarily higher cathode voltage drop and increased ion bombardment. He also pointed out the damaging effect of high ion velocities resulting from steep current wave fronts. Circuit designs having such characteristics will promote sputtering of lead wires, hence, spot formation.

Certain preheat ballasts of lead-lag design are characterized on the lead side by low preheat current and high open circuit voltage. Instant starting often occurs and life tests of lamps under such conditions disclose shortened lamp life as well as early spot discoloration due to sputtering by high energy ions.

In series sequence starting circuits, the starting mechanism is such that one of the two lamps in series may be subjected to a glow discharge of up to 150 milliamperes for a period of a few seconds. This condition, unfavorable to lamp life and cleanliness, becomes serious if conditions are not favorable for quick starting, for example, if the primary voltage is too low.

Rapid start systems are such that the cathode heating voltage is very important. If for some reason the cathodes are insufficiently heated, for example due to poor contacts, the lamp cathode is subjected to ion bombardment at starting and spotting will result.

These examples of circuit influence have been cited to emphasize that the constant efforts of lamp manufacturers to improve lamp cleanliness can be fully productive for the user only if recommended lamp operating conditions are maintained satisfactorily.

Acknowledgment

The authors wish to acknowledge the generous assistance of George S. Evans and those members of the Research Staff who gave so freely of their time and experience.

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DISCUSSION

JAMES L. COX:* This paper is excellent, explaining fully, the causes and mechanics of spot formation. Data obtained by our own engineering department substantiate the author's data on spot formation.

The paper indicates that conditions which form spots are opposite of those which form bands. The authors refer to "balance in exhaust conditions" as a means of oxygen balance control against formation of spots or bands. No explanation is given as to why or how bands are formed or why the black lead wire aggravates an already existing band condition.

An oxygen balance in production seems to be a very difficult thing, if not impossible, when all processes are considered. A spot condition one day may be a band condition the next. The use of electrode material to counteract a spot condition would be ideal as long as oxygen balance is toward a spot condition. But anything that contributes oxygen to upset oxygen balance in the opposite direction will

*Duro-Test Corp., North Bergen, N. J.

then cause bands, and electrode material will then contribute to band formation.

We have used the black lead wire on a test basis to reduce spot formation but have experienced bands at times. This material is very interesting and has shown promising results at times, but until all variables are conquered, we hesitate to use it in the production of fluorescent lamps.

J. R. MORIN:* This paper has, as the authors hoped, contributed greatly to a better understanding of the role of electrode materials in fluorescent lamp end discoloration. Past investigators have overlooked lead wire materials as a possible source of trouble. This paper should therefore stimulate further study in this area.

The results obtained from our work with black plated leads are in general agreement with that obtained by the authors. We have found a similar reduction in spotting. We have also found that lamps manufactured with the black plated leads are very sensitive to processing conditions and in some cases serious banding results.

We would like to ask the authors the following questions:

(1) Have d-c experiments been conducted to separate anode from cathode phenomena; if so, what were the results?

(2) Figs. 3 and 4 illustrate life tested lamps at several thousand hours; could the authors be more specific?

(3) Have the authors studied lead wire temperature and its effect on end spotting?

Our early work on black plated leads showed a 100C drop in clamp temperature. Other means of lowering the clamp temperature such as wider spacing of leads, larger diameter leads and larger area cathodes were tried. In all cases spotting was greatly reduced by a decrease in lead wire temperature with no change in the lead wire material.

End discoloration is a complex subject. Many factors can influence end discoloration behavior of lamps. The authors are to be congratulated for stimulating work leading towards a better understanding of end discoloration.

J. O. AICHER:** This paper appears to be the result of careful and logical work on investigation of mechanisms of bulb discoloration of fluorescent lamps. Inclusion of instances of marginal results and of items requiring additional study marks it as a truly engineering-type of presentation.

The authors have suggested a very interesting theory to explain dense spot formation that is consistent with their spectrographic analyses, their many laboratory tests and observations and with general fluorescent lamp theory. We feel that this theory, involving four sequential steps, is unduly complicated. We also believe that this theory alone does not sufficiently differentiate between the mechanism of formation of areas of diffuse darkening and areas of severe darkening. We feel that a different mechanism is required to account for the sharp boundaries of the dense spot.

A note by M. A. Cayless and A. D. Forster-Brown[1] points out that areas of the bulb wall that have received barium ions have a lower work function than wall areas not so contaminated, and that these areas develop opacity, due to further metal collection, more rapidly than their surrounding areas do.

We believe that this can be explained by the reduced speed with which a positive barium ion would strike the wall in an area of low work function. This lower impact energy may permit the existence of compounds which would be decomposed in areas of higher work function with corresponding increase in energy of bombardment. This dynamic situation, we feel, is an essential consideration in the formation of sharp boundaries in discolored areas, and is discussed in a paper by Dr. Carl Kenty and Miss Jeanette R. Cooper.[2]

Effect of material of the inner leads can be exerted through differences in ease of evaporation and sputtering of their surfaces as well as through stability of compounds or amalgams of their material on the bulb wall, to the ion bombardment differentials that have just been discussed.

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2. Kenty, C., and Cooper, J. R.: "Study of the Effects of Gas Impurities in Fluorescent Lamps," *Transactions of the Electrochemical Society*, Vol. 87, p. 397 (1945).

A. W. WAINIO AND F. M. CRAVEN:* We appreciate the comments and thank these three discussors.

We are particularly happy to note that this paper has stimulated interest in a problem common to all fluorescent lamp manufacturers. This kind of interest will bring forth more and better solutions to our problems.

With respect to Mr. Cox's discussion, we did comment on the how and why of end banding and added that a banding condition could be aggravated by oxygen released from the black plating, the mechanism of which we are presently investigating. The established pattern of discoloration should be predominantly spots before relying on black plated iron for assistance. Use of black plated material also presupposes consistently good exhaust conditions or the possibility of developing bands exists.

In regard to Mr. Morin's request for results on d-c operation, our experience shows the following:

(1) Spot discoloration may form at either end of the lamp although it is predominantly on the anode end on d-c.

(2) Bands form only at the cathode end.

(3) We feel that you cannot duplicate a-c conditions or effects with d-c operation.

For his second question, we can add that Figs. 3 and 4 represent about 4000 hours of burning on a 3-hour 20-minute cycle. These are laboratory-made lamps which have been reduced in gas pressure to induce earlier discoloration.

With respect to his third question, we have noted this drop in lead wire temperature with the use of black plate; however, other tests with different materials indicate that this is not the entire story. Sputtering is a complex phenomenon which cannot be tied to any single characteristic of material or condition of operation. We do agree that temperature will affect evaporation and sputtering rates. For this reason we must tailor the lead wire size to fit the lamp operating conditions, if we are to obtain the optimum advantage of black plated iron lead wires.

Mr. Aicher cites the work of Cayless and Forster-Brown in which it is pointed out that a bulb wall area with barium deposits, tends to darken more rapidly than surrounding areas. It is suggested that material is transported as ions, the diffusion of which will be modified by the work function of the wall. We do not consider this to be inconsistent with the theory we presented, but rather being a possible refinement in the electric field conditions which we stated were responsible for determining the location and concentration of sputtered deposits. In our paper we clearly point out that released barium becomes ionized in part and hence is subject to the effects of electric fields.

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**General Electric Co., Cleveland, Ohio.

*Authors.

INSTALLATION AT WOODS GOLF DRIVING RANGE AND MINIATURE GOLF COURSE, NORRISTOWN, PA.

Lighting a Miniature Golf Course

LIGHTING OBJECTIVE: To illuminate a miniature golf course for evening use.

GENERAL INFORMATION: Fig. 2 shows the size of the playing area.

INSTALLATION: Twenty-two Benjamin Ellipto-Lite No. 5977 luminaires with 750-watt clear general service lamps are mounted two per pole 25 feet above the ground approximately 40 feet apart around the perimeter of the playing area. A center pole supports four similar units equipped with 1500-watt clear general service lamps. After 500 burning hours the resulting average illumination was 10 footcandles.

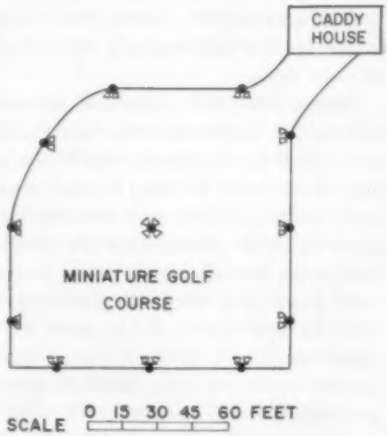

Fig. 2. Plan view.

Lighting designed by George C. Linthicum, Philadelphia Electric Co.; installed by Woods Electrical Service, Center Square, Pa.

Lighting data submitted by George C. Linthicum and George T. Anderson, Jr., Philadelphia Electric Co., as an illustration of good lighting practice and to aid in the design of similar installations.

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A.I.A. File No. 31-f

Effects of High Operating Temperature On the Lamp Envelope

By F. A. LOUGHRIDGE

INVESTIGATION of the cause of failures of those types of mercury vapor lamps which have a soda lime glass outer bulb or envelope indicates that one type of failure is due to physical deterioration of the glass. The mercury arc tube in this type lamp is contained in a glass bulb to control the heating rate during the starting cycle, to prevent oxidation of arc tube seals and to control the rate of heat dissipation during lamp operation. Especially in installations where open fixtures are used, the outer bulb must be strong enough to avoid fracture.

A casual examination of the fragments of some bulbs, which had been operated under conditions likely to produce glass deterioration, showed no apparent cause for failure, but closer observation with a Burton spotlight brought out the presence of hundreds of small fissures or cracks in the outer surface of the bulb. These cracks cannot be seen with ordinary light but are readily apparent when an intense beam of parallel light is used. This is true of a variety of glass defects, such as firecracks, which are far more serious than many of the more obvious flaws.

Lamps were next examined at various stages of life, and it was found that the cracks start to appear after approximately 2500 hours burning and they occur only in lamps using a soda lime glass outer bulb. Lamps made with boro-silicate or hard glass bulbs do not develop the crazing. There has been some thought that water evolution from the hard glass bulb would be detrimental to arc tube life. In practice, this has been no problem, and lamps made with this glass have been operated far beyond rated life with excellent performance characteristics.

A heavy white haze develops on the lime glass bulb during operation, characteristic of the weathering phenomena so well known to the glass industry. Glass is not quite as stable chemically as many people believe it to be. It is chemically attacked by moisture and gases present in the normal atmosphere. This corrosion is not a case of simple solution in water, but is a highly complex process, involving the penetration of the glass by water and the subsequent decomposition of the complex silicate mixture with formation of substances wholly different from those originally present.[1]

There is a great difference in the chemical durability of the various commercial glasses. In general, glasses with high alkali and low silica content tend to be rather poor. The boro-silicate or hard glasses have high silica content, low alkali and are far superior to the ordinary lime glass. In general, the rate of attack increases as the temperature increases. The rate of corrosion can be influenced by the presence of chemical vapors with the low silica glasses being more subject to acid corrosion and the high silica glasses more subject to basic corrosion.[2]

The haze which appears on the soda lime glass is a crystalline deposit of the products of decomposition of the glass, mainly alkali salts, and usually can be removed by washing the surface with hot water. After these salts are removed, examination of the surface with a microscope will show severe etching and pitting when advanced weathering has taken place. Fig. 1 is a photomicrograph of the surface of a mercury vapor lamp which has burned over 7000 hours. The deposits of crystalline weathering products and surface cracks are readily apparent on the outer surface of the lime glass bulb. Fig. 2 is a photomicrograph of another lime glass bulb from a mercury lamp burned over 7000 hours. This surface has been cleaned with hot water and the severe pitting resulting from weathering is evident.

To determine the effect of the weathering deposit on light transmission, three lamps, which had been severely corroded by long burning, were measured for total light output before and after washing the surface of the bulb with hot water. The results shown below indicate that the light absorption is not very high.

Sample No.	Total Lumens Before Washing	Total Lumens After Washing
1	9,520	9,600
2	14,360	14,460
3	6,180	6,200

A paper presented at the National Technical Conference of the Illuminating Engineering Society, August 17-22, 1958, Toronto, Ont.
AUTHOR: Sylvania Electric Products Inc., Salem, Mass.

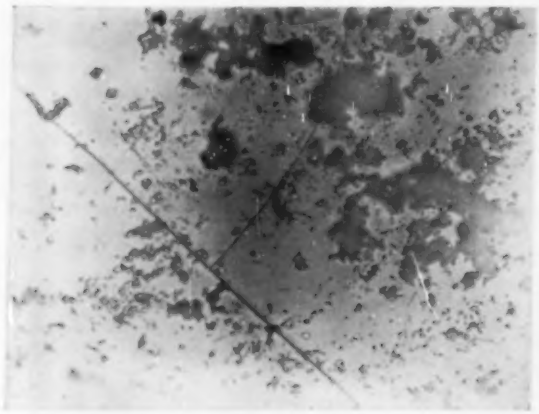

Figure 1. Photomicrograph of surface of mercury vapor lamp which has burned over 7000 hours. Deposits of crystalline weathering products and surface cracks are readily apparent on outer surface of lime glass bulb.

Figure 2. Photomicrograph of another lime glass bulb from a mercury lamp burned over 7000 hours. Surface has been cleaned with hot water and the severe pitting resulting from weathering is evident.

The practical strength of glass has been found, by many investigators, to be determined primarily by the condition of the surface. The presence of surface scratches and flaws lowers the strength far below the theoretical values.[3] Brodmann[4] found that by removing the surface glass with mild hydrofluoric acid solutions substantial increases in strength can be obtained.

Fig. 3 is data presented by E. B. Shand[5] from experimental work carried out by the research laboratory of the Corning Glass Works, reported by C. J. Phillips. The graph shows the results of a series of tests on ¼-inch diameter glass rods in which each group was loaded in bending to a different stress and the stress plotted against time required for failure. It points out the decrease in strength of glass with time. Surface deterioration is one of the most accepted theories explaining this loss in strength.

There is a substantial variation in the degree of

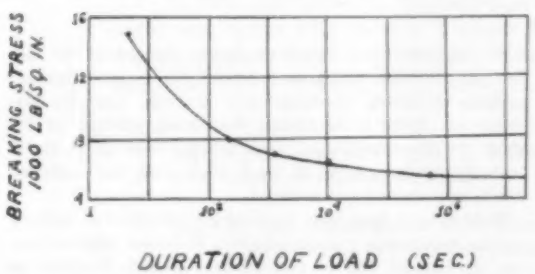

Figure 3. Results of series of tests on ¼-inch diameter glass rods in which each group was loaded in bending to a different stress and the stress plotted against time required for failure.

pitting in various areas of the surface of these bulbs which is probably due to micro-inhomogeneity in the glass itself. Particle size of the raw materials used in the glass batch is a likely cause of this condition, along with the high melting rates used in modern large scale glass melting. Areas representing the location of large quartz grains, or agglomerates of quartz grains would be silica rich and have good chemical durability. It is sometimes possible, with the petrographic microscope, to see the skeletal structure of quartz remaining, even though the glass appears to be completely transparent and fully melted.

The glass container industry commonly treat their product with sulphur dioxide gas at elevated temperatures to improve the chemical durability. A test was run to compare the durability of normal soda lime glass, sulphur dioxide treated glass and boro-silicate glasses in mercury vapor lamp bulbs. The three groups of lamps were burned in the same vessel in a moisture rich atmosphere. The rate of attack was greatest on the normal lime glass. Sulphur dioxide treated glass was slower to weather, initially, but gradually became as severely corroded as the untreated material. The hard glass showed very little weathering under these conditions.

During the heating and cooling cycles of the mercury lamp, the outside surface of the bulb is subjected to a temporary tensile stress due to the tempearture gradient across the wall of the bulb. Apparently the tensile strength of the surface drops to the point where it will no longer support these stresses in the case of the lime glass bulb. When this occurs, the fractures develop and failure

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eventually occurs. The cracks have been found in the sulphur dioxide treated bulbs, also, but not in lamps made with hard glass.

The boro-silicate glass has the added advantage of low thermal expansion so that the temporary stresses are much lower under the same thermal gradients. It will even withstand the thermal shock of droplets of water falling onto the surface of the hot lamp. The lime glass will not take this treatment.

This loss of strength of glass is very likely the explanation of other types of delayed glass failures which sometimes trouble the electric lamp industry. In the case of most cracked stem presses, a permanent or frozen in tension stress is left on the inside surface of the barrel portion of the stem. This surface becomes weakened by atmospheric corrosion until the tensile strength drops to the point where the stresses present cause the glass to rupture. In some cases, temporary stresses are added during the start up cycle which help the permanent stress present to exceed the strength of the glass. Proper annealing of the stems will normally prevent this type of failure.

The mercury vapor lamps have extremely long life as compared to ordinary incandescent lamps, which are designed for a shorter life. In view of the superior chemical durability of the hard glass and its excellent thermal endurance, it seems to be the best material for the mercury lamp outer bulb. No matter what type of glass is used, however, good practice must be used in handling the lamp to avoid severe abrasion of the outer surface and subjecting it to undue temperature gradients. In installations where high humidity, high temperature, or chemical vapors are present, the hard glass bulb is most desirable for reliable performance.

Acknowledgement

Photographs shown as Figs. 1 and 2 were made by R. Pashby of Sylvania Lighting Products Inc., Incandescent Research Laboratory, Salem, Mass.

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DISCUSSION

R. M. TICHANE:* The author is to be commended for his contribution to the better understanding of the parameters influencing mercury vapor life.

Because of the chemical aspects of the attack of glass surfaces exposed to the atmosphere, the question arises as to whether analyses have been made of the decomposition products washed from the glass bulbs. One would be interested in whether these products on the glass surface contain only elements common to the glass batch or whether significant amounts of non-glass originating cations and anions are detected. If the first instance were the case, then moisture might be the main culprit in this type of glass weathering. If the second case were found, then the particular acidic and components of the atmosphere which participate in the surface attack might be found.

Certainly, the use of borosilicate-type hard glass is to be recommended for high temperature lamp operations, especially where water drops or well-hydrated bugs are encountered.

M. C. UNGLERT:* Based on much work done in investigating this condition, it is our opinion that the fine cracks noted by the author are caused by the alkaline material in the outer surface combining with various gases in the air, particularly sulphur dioxide. This action leaves a silica rich layer of glass at the bulb surface which cracks because of the difference of expansion between the now changed surface and the body of the glass.

Other glass treatments and coatings have been developed to retard this action besides the sulphur dioxide treatment mentioned in the paper, but none is completely satisfactory and none approaches the durability of the hard glass bulb.

E. C. MARTT:** We agree with the author that unprotected lime glass jackets for mercury lamps craze badly after 2500 hours of burning. We encountered the crazing problem several years ago and had about the same difficulties as are described. We ran a series of force tests and life tests for different treatments, and found that the crazing could be eliminated for at least 12,000 hours of burning when the tests were stopped. Since this suitable treatment was developed, our mercury lamps with lime glass jackets have operated satisfactorily with no crazing problems. A recent field study has verified this.

The use of a more expensive hard glass in place of treated lime glass generally increases lamp cost. Customers who do not need the weather resistant features of hard glass may not want to pay a premium price for such lamps. Lime glass bulbs, when protected from crazing, are perfectly satisfactory for most applications. The author's conclusion that hard glass " . . . seems to be the best material for the mercury lamp outer bulb" applies only to limited applications and for soft glass lamps which are not fully protected from crazing.

F. A. LOUGHRIDGE:† The white deposit formed on the surface of the bulb has been subjected to various chemical analyses including spectrographic analysis, and the materials are found to be normal weathering products of the glass. In the presence of acid vapors, however, it would probably contain salts of those acids and the corrosion would very likely be accelerated.

Field surveys have been made which indicate that existing surface treatments are not adequate to insure against crazing. In view of this, we feel the hard glass bulb should be used for most mercury vapor lamp envelopes.

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†Author.

INSTALLATION AT HARWOOD-NELSON MEN'S SHOP, MUSKEGON, MICH.

Lighting a Men's Furnishing Store

LIGHTING OBJECTIVE: To provide an attractive environment and suitable illumination for merchandising men's clothing.

GENERAL INFORMATION: This 80- x 20- x 14-foot store is 70 years old. After redecorating, the interior finishes were as follows: walls, sand brown, 50% RF; floor, mottled grey, 50% RF; display cases, quartered oak, 35% RF.

INSTALLATION: A false ceiling of Sylvania Sylvan-aire corrugated vinyl plastic, in three-foot wide strips, was installed three feet below the old ceiling and the plenum above painted white (75% RF). Above the plastic are continuous rows of 96-inch T-12 Super Deluxe cool white fluorescent lamps in 27 Sylvania catalog No. CS-29616-IS tandem channels mounted on three-foot centers. The 54 lamps are switched to provide 25, 40 or 60 footcandles. Local lighting is provided by eight case lights with 30-watt T-8 fluorescent lamps and a valance at the right wall containing twelve 40-watt rapid start Super Deluxe cool white lamps. The store brightnesses with full illumination measure: walls, 13 fL; floor, 15 fL; display cases, 11 fL; ceiling at 45 degrees, 90 fL.

Lighting designed by Fitzpatrick Electric Co. and installed by Vandervere Electric Co., both of Muskegon, Mich.

Lighting data submitted by R. F. Osmun, Consumers Power Co., Muskegon, Mich. as one solution to a lighting problem and to aid in the design of similar installations.

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A.I.A. File No. 31

Here and There With I.E.S. Members

LIGHTING Progress was the topic of interest at this meeting of the Southern California Section's Study Club. Over 80 members attended the session to hear discussion by the panel of experts: Roy Jones, Roy Bevan, Bill Middleton, J. N. Robertson and Bill Jones, Study Club Chairman.

WATCHING the light meter at the opening of The Wakefield Co.'s enlarged offices in London, Ont. are, left to right: T. D. Wakefield, Norman H. Scott, Ralph A. Yates, Willard C. Brown and A. F. Wakefield. *Photograph courtesy of the London Free Press.*

FEATURED speaker at the installation meeting of the Mid-South Chapter was Jan Reynolds (center) who spoke on Residence Lighting. Shown with Miss Reynolds are R. V. Ridenour (left), newly-elected secretary and Charles Shapard, the Chapter's vice-chairman.

ENGRAVED cigarette box was presented to Society Director Joseph Thomas (left) at the Annual Convention of the Canadian Paint, Varnish and Lacquer Association in Winnipeg, in recognition of his contributions to the paint industry through work on "Clean Campaigns." Charles Pettit (center), president of the Association, made the presentation. Also honored at the meeting was Jack O'Rourke (right), President of the Canadian Junior Chamber of Commerce.

LIGHTING NEWS

Yosemite Chapter Has Gala Charter Night

If best wishes and enthusiasm from all concerned can bestow good fortune on any enterprise, the future of the new Yosemite Chapter of IES should be a rosy one. Charter night activities of the group were held September 16, at the Desert Inn, Fresno, Calif., with well-wishers attending from all over the state. Fifty members of the "parent" Golden Gate Section made the 350-mile round trip from San Francisco by bus; eight members came from the Mother Lode Chapter in Sacramento and five from San Jose. San Diego and Los Angeles were represented. Also present were interested members of the Optometric Society and the American Institute of Architects.

Presentation of the charter, by then Regional V-P Carleton M. Holden, and of the gavel, by Golden Gate Chairman Chick Macy, and installation of officers were, of course, major items on the agenda. Other ceremonies included the presentation, by Chapter Secretary Edward Bowen, of a certificate of appreciation to Mr. Macy; the gift of two IES emblems (giant size) by the Golden Gate Section, and conferral of honorary mayor-ship on Chapter Chairman Irwin McMath by the City of Fresno, together with a gold key to the city.

Officers installed on Charter Night are: Irwin A. McMath, Chairman; Laurence Barre, Vice-Chairman; Edward F. Bowen, Secretary; Glenn A. Baker, Arch McDougald, C. H. Wissing and Chairman Jack Hammond, Board of Managers.

Electrical Men Visit Russia On Technical Exchange Program

A group of ten electrical industry executives, headed by Walker L. Cisler, President of Detroit Edison Co., recently traveled to Russia to visit electric power systems and plants that manufacture electrical equipment, as part of a technical and cultural exchange conducted by the US and USSR.

The inspection trip, which lasted about three weeks, was conducted under the auspices of the State Department, and was sponsored by the Edison Electric Institute and the Association of Edison Illuminating Companies, a trade association of American electric utilities.

Planning Kit Distributed For National Electrical Week

Planning Guide for the 1959 National Electrical Week, Feb. 8-14, is now being distributed throughout the country. Centered around the N.E.W. theme, "Electricity Builds Jobs," the kit contains suggested publicity copy, information on how to participate in National Electrical Week, Science Youth Day materials and a list of other publicity aids available on order. Additional copies of this Guide, at $1.00 per copy, may be ordered from the National Electrical Week Committee, 290 Madison Ave., New York 17, N. Y.

The theme for the 1959 celebration was announced at a recent meeting of the N.E.W. Committee in New York City.

Yosemite Chapter Chairman Irwin McMath (second from right in photo at left) accepts Charter from then Regional V-P, C. M. Holden, while Chick Macy, Golden Gate Chairman (far left) and Jack Hammond, Chairman of Yosemite's Board of Managers, look on.

In photo at right, the new Chapter's officers, from left to right, Back row: Chairman McMath, C. H. Wissing, Board of Managers; middle row: Arch McDougald, G. A. Baker, Jack Hammond, all of the Board of Managers; front row: E. F. Bowen, Secretary; Laurence Barre, Vice-Chairman.

TECHNICAL Advisory Committee on Light and Vision of the Illuminating Engineering Research Institute meeting in Toronto with Messrs. Chorlton and Davidson, to consult with them on their studies on specular reflection in classrooms. This study is being financed by the Board of Education of Toronto and has been adopted as Project No. 65 by the IERI. Left to right are: Dr. Glenn Fry, Prof. Everett Strong, Willard Allphin, C. L. Crouch, Dr. S. K. Guth, Dr. H. Richard Blackwell, Hedley Davidson (hidden), Marion Curry and J. M. Chorlton, Chairman of the School Lighting Committee of IES.

Hotel Strike Cancels AIEE Fall Meeting

AIEE's Fall General Meeting, scheduled for October 26-31 at the Penn-Sheraton Hotel, Pittsburgh, was cancelled by vote by the Executive Committee of the Institute. Reason — the unsettled hotel strike in that city.

The action of the Executive Committee was announced on Friday, Oct. 17 to allow time to notify the more than 50,000 members of AIEE. The 250 technical papers scheduled to be read at the meeting will be considered as having been presented and those which have been approved as transactions papers will be printed in the official literature of the Institute, according to their Executive Secretary, N. S. Hibshman. Discussion by mail of both transactions papers and conference papers by December 1, is invited by AIEE. Pre-printed numbered papers may be secured by writing to the Institute at 33 West 39th Street, New York 18, New York.

Approximately 3,000 engineers from all parts of the country were expected to attend the meeting.

(*Lighting News continued on page* 15A)

According to N. J. MacDonald, chairman of the committee, the choice was spurred by the fact that today there are 3,194,000 people employed in seven categories of the electrical industry, as compared to 1,321,900 in 1939.

It is expected that within the next few months over 250 local groups will be formed to implement local programs for National Electrical Week.

Eastern Pennsylvania Section Begins Publication of Newsletter

Volume 1, Number 1 of *The Light-er Side*, newsletter of the Eastern Pennsylvania Section made its appearance in October. According to Editor John R. Fritz, the Section's Board of Managers decided to publish the bulletin to promote better understanding of IES and lighting in a Section whose geographical expanse prohibits frequent personal contact among members.

The first issue of the newsletter contained a report from Chairman R. J. Pretzman and the news that the Section will sponsor Advanced Illumination courses in Allentown, Lancaster, Reading and Harrisburg through the facilities of the Pennsylvania State University Centers. Also noted were themes of future meetings: Home Lighting and Christmas Decorations in November and the 1958 Lighting Progress Report, as it was presented in Toronto by Chairman E. A. Linsday, for January.

From the desk of the President . . .

This is the first of a series, hopefully one each month, of what I would like to consider informal IES shop-talk with IES members — or anyone else enough interested in lighting to open these pages. This organization does its best work through its members — maybe its only work. So it is to them I would like to talk, especially. There are any number of subjects; they pop up in conversations all the time. Some pretty impressive progress stems from just such discussion.

The first subject I'd like to introduce is in the nature of a proposition. That is: that we get ourselves across to the *public*. It so happens we are *the* source in this country for authoritative, unbiased, factual information on lighting. The public should know this, and know all about us.

Some of the public knows us, as well as they know the AMA, for instance. It has no doubt happened to many of you when a School Board, say, on getting a footcandle recommendation, asks "Who says we need this? The public utility? The fixture manufacturer? — the Illuminating Engineering Society says so." That's the authority they respect. They know about us; they're familiar with IES and what it stands for.

There are many other elements of the public which should be equally familiar. From the office building superintendent to the plant manager to the housewife — IES should be known, and considered the authoritative last word. It has to be individuals, or companies, who make the specific lighting recommendation — but the user of light in whatever field really should know enough about IES to accept its backing for installations which meet its practices.

How to get such confidence across to the users? Through the membership, mainly. Talk it up, individually. Through Section and Chapter activities — invite outside groups to IES meetings, or get someone on their programs. These could be civic and service clubs, alumni meetings, PTA, school assemblies, photographic clubs, law and trade associations, medical, religious groups, local architects, contractor meetings — to name just a few of the possibilities.

Right now, of course, we have an item every element of the public should be interested in. That's the just-developed method of evaluating how much light we need (see August IE, p. 422). The new footcandle recommendations developing from the Blackwell studies should be widely disseminated. New levels will meet with quicker acceptance, however, in those areas in which the IES is known. Let's get ourselves across!

GEORGE J. TAYLOR
IES President

This luminous ceiling gives

even light readings across the room

A luminous ceiling fills this room with shadow-free light—no spot too glaring, none too dim.

The panels are made of BAKELITE Brand Rigid Vinyl Sheet. They are extremely light in weight, so installation and maintenance are simple. They resist discoloration. They can be corrugated or formed with a patterned design in relief. Light is evenly diffused, never concentrated.

You can light any area of any size with a luminous ceiling made of BAKELITE Brand Rigid Vinyl Sheets. Get all the facts now. Write Dept. KN-20K, Bakelite Company, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y.

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FIRST FILAMENT From this small bulb, Mr. Edison's first successful filament bulb in 1879, has mushroomed the lighting industry of today.

FIRST MERCURY I 1934, General Electric co-introduced the high e' iency A-1 Mercury Lamps that reduced the cos. 'f industrial lighting.

1938

Precision PAR projector lamps with superb beam control, air-tight seal of lens to reflector.

1942

Instant Start fluorescent gave quicker start, long life because of the G-E triple coil cathode.

1945

Slimline fluorescent with slender, graceful tube for more attractive lighting systems.

1952

RC-1 Mercury Lamp with color improved reflector; phosphor coating increased lamp efficiency 54%.

1954

High Output fluorescent delivered half again as much light as slimlines, more light from equal fixtures.

1954

Quartz Infrared—a powerful, compact new heat source with high concentration of radiant energy.

Progress Is Our Most Important Product

OPERATION up turn

GENERAL ELECTRIC

GENERAL

CONTRIBUTIONS TO LIGHTING FROM GENERAL ELECTRIC

FIRST FLUORESCENT Exactly 20 years ago, 1938, General Electric contributed the first fluorescent—a revolutionary increase in lighting efficiency.

ISN'T IT AMAZING? Each of these lamp types, and improvements in lamps, for commercial and industrial lighting, were developed and introduced into public use by G.E. to give your customers more value for all their lighting costs. Here are fifteen outstanding, but by no means *all*, of General Electric's contributions. The proud histories of General Electric and the lamp industry have gone side-by-side since the basic contributions of Mr. Light himself—Thomas A. Edison.

ISN'T IT LOGICAL? The company that gives your customers more value in new lamps and new improvements—and has been making both for a longer time—is also the company that makes the lamps that will be their best bet for day-in, day-out service and lowest operating cost. These accomplishments from General Electric can help you on your job. For more help or information on any G-E Lamp or service, call your local G-E Large Lamp representative. (C-842)

1950

R-52 Reflector Lamp—sealed-in reflector never needs cleaning, 500- and 750-watt sizes.

1952

Rapid Start fluorescent brought faster, flickerless starting *without* starters . . . cut maintenance, too.

1952

R-1 Reflector Mercury gave maintenance advantages of inside reflector, plus mercury lamp efficiency.

1955

RB-52—This design improvement made practical a regular glass, 1000-watt reflector lamp for high bay use.

1955

Bonus Line of filament lamps increased light output up to 15% by G-E stand-up filament design.

1956

Power Groove—This revolutionary lamp gives 2½ times the light of slimline; saves 5 to 20% on initial cost.

GE ELECTRIC

IT'S A FACT: Over the past 3 years, General Electric has averaged a new lamp *every other working day!*

150 FOOT CANDLES

AT DESK HEIGHT **without a**

"FIXTURE JUNGLE"

Standard 4-Lamp ASTRA-LITE Luminaires on 7-Foot Centers Maintain High Lighting Intensity for This Travel Agency at Minimum Cost

Providing light in large quantities is no trick, of course. But doing it at reasonable cost, without "over-fixturing" the ceiling, is a task more and more lighting men are assigning to METCO's ASTRA-LITE, the best unit you can specify today for maintained lighting intensity. This installation of 96" ASTRA-LITE slimline luminaires in ground floor offices in the Fidelity-Philadelphia Trust Building provides comfortably diffused lighting for employees, an attractive glare-free setting for customers. It was laid out by illuminating engineer Jack Green, of the building staff, and installed by the building's electrical department. Suspended on 12" stems, these units are equipped with curved plastic side reflectors and shielded with 35° x 25° projection welded metal louvers.

ASTRA-LITE is available in 2 and 4 lamp units, slimline or rapid start, 4, 6 and 8 feet, with curved glass, plastic or metal shielding and a variety of metal louvers. Write for Bulletin RL-1257.

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(*Lighting News continued from page* 10A)

The IES Gold Medal — How It Happened

During the administrative year 1942-1943, R. B. Brown, Jr., as President of IES, received an invitation from the President of the American Chemical Society to attend ceremonies incident to the presentation of the Society's Annual Medal Award, to take place in Cincinnati, Ohio. It appeared to be a custom of this Society to invite the heads of all Technical Societies to attend this particular ceremony, and undoubtedly, some of them attended from time to time. There was no history of the President of the Illuminating Engineering Society ever having attended such a function and, of course, there were no funds available for the purpose, at least during the period mentioned.

Since the ceremony was to be held in Cincinnati and the IES President was personally acquainted with Paul H. Goodell, a resident of Cincinnati whose interest and activity in Society affairs were well known, Mr. Goodell was asked to attend the ceremonies as Mr. Brown's personal representative. Mr. Goodell not only attended the meeting, but also reported it to the IES President in an enthusiastic letter containing a recommendation that IES might well consider the establishment of such an award. Because of the prevalent war-time conditions and because the IES was never flush with funds for such a purpose, Mr. Goodell's proposal might well have fallen on deaf ears, or at best, have been filed away to be considered in the indefinite future. However, for reasons which will be explained, President Brown chose to present an argument to the Council in favor of the proposal, as a result of which an Advisory Committee was appointed to study the matter.

In support of an IES award, the President called attention to the recently established "New England Award," presented by the Engineering Societies of New England, consisting of a suitably embossed certificate or scroll, not involving a large financial expenditure. (It might be said that the Engineering Societies of New England also operated on a very tight budget and any award having substantial monetary value would have been out of the question.)

The IES Council agreed that the idea was worth investigating, and President Brown was authorized to appoint an Advisory Award Committee. A. D. Cameron was named Chairman of the committee, with D. W. Atwater, Paul H. Goodell, L. H. Graves and S. B. Williams serving as members. Messrs. Cameron,

(*Continued on page* 19A)

SCHEDULED EVENTS

November 17-21, 1958 — Eighth Annual Plastics Exposition and National Conference of the Society of the Plastics Industry, Inc., International Amphitheater, Chicago, Ill.

November 18-20, 1958 — American Standards Association (9th Annual Conference on Standards). Hotel Roosevelt, New York, N. Y.

December 11, 1958 — Council Meeting, Illuminating Engineering Society, New York, N. Y. Members are free to attend meetings of Council as guests.

January 19-23, 1959 — American Institute of Electrical Engineers (Winter General Meeting), New York, N. Y.

January 26-29, 1959 — Plant Maintenance and Engineering Show, Public Auditorium, Cleveland, Ohio.

January 27-29, 1959 — Society of Plastics Engineers, 15th Annual Technical Conference, Hotel Commodore, New York, N. Y.

February 8-14, 1959 — National Electrical Week.

February 12, 1959 — Council Meeting, Illuminating Engineering Society, New York, N. Y. Members are free to attend meetings of Council as guests.

March 1-4, 1959 — Second National Lighting Exposition, New York Coliseum, New York, N. Y.

March 1-4, 1959 — National Electric Sign Association, Morrison Hotel, Chicago, Ill.

March 24-26, 1959 — First Biennial Chicago Electrical Industry Show, Hotel Sherman, Chicago, Ill.

March 30 - April 1, 1959 — Chicago Electrical Industry Show, Hotel Sherman, Chicago, Ill.

April 9-10, 1959—East Central Regional Conference, Lord Baltimore Hotel, Baltimore, Md.

April 22, 1959 — Council Meeting, Illuminating Engineering Society, Asheville, N. C. Members are free to attend meetings of Council as guests.

April 22-24, 1959—South Central and Southeastern Regional Conference, Grove Park Inn, Asheville, N. C.

May 3-8, 1959 — Society of Motion Picture and Television Engineers, The Fontainbleau, Miami Beach, Fla.

May 4-5, 1959 — Southwestern Regional Conference, Shamrock-Hilton Hotel, Houston, Tex.

May 6-8, 1959 — Midwestern Regional Conference, Pere Marquette Hotel, Peoria, Ill.

May 11-12, 1959 — Inter-Mountain Regional Conference, Continental Hotel, Denver, Colo.

May 24-29, 1959 — National Association of Electrical Distributors (51st Annual Convention), Conrad Hilton Hotel, Chicago, Ill.

May 26-30, 1959 — Pacific Northwest Regional Conference, Banff Springs Hotel, Banff, Alta.

June 4-5, 1959 — Northeastern Regional Conference, Curtis Hotel, Lenox, Mass.

June 11, 1959 — Council Meeting, Illuminating Engineering Society, New York, N. Y. Members are free to attend meetings of Council as guests.

June 11-12, 1959 — Canadian Regional Conference, Chateau Laurier, Ottawa, Ont.

June 22-23, 1959 — Great Lakes Regional Conference, Statler Hotel, Buffalo, N. Y.

June 22-26, 1959 — American Institute of Electrical Engineers, Summer and Pacific General Meeting, Seattle, Wash.

October 5-10, 1959 — Society of Motion Picture and Television Engineers, Hotel Statler, New York, N. Y.

October 12-14, 1959 — National Electronics Conference, Inc., Hotel Sherman, Chicago, Ill.

October 12-16, 1959 — American Institute of Electrical Engineers, Fall General Meeting, Chicago, Ill.

November 2-5, 1959 — Eleventh Exposition of the Air-Conditioning and Refrigeration Industry, Convention Hall, Atlantic City, N. J.

November 9-13, 1959 — National Electrical Manufacturers Association, Traymore Hotel, Atlantic City, N. J.

January 30 Is Deadline For 1959 Conference Paper Outlines

The Papers Committee of IES has set a deadline of January 30, 1959, for outlines of proposed papers for the 1959 National Technical Conference. Outlines of proposed papers, in triplicate, should be mailed to:

Floyd W. Sell
c/o The Detroit Edison Company
2000 Second Avenue
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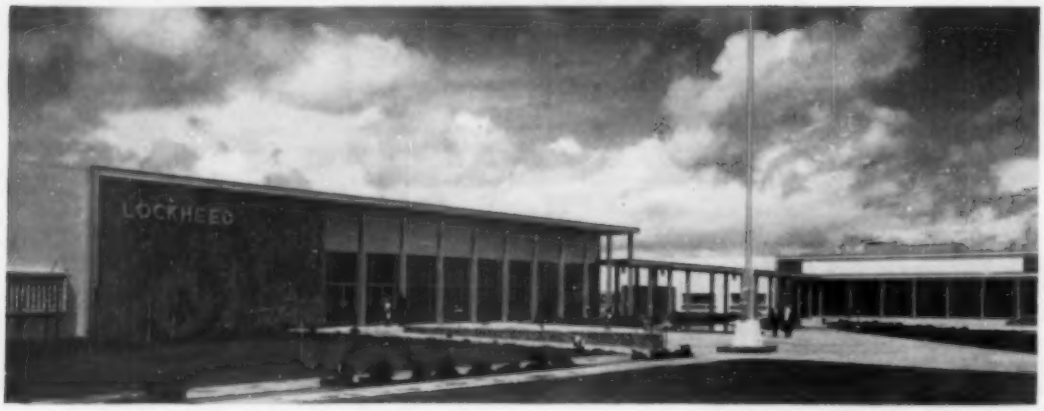

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How much your clients get for their investments in *floor* space depends in large measure on how effectively you utilize *ceiling* space.

Day-Brite helps you make the most of the ceiling with fixtures that simplify mechanical planning, give a "custom installation" appearance, and provide the proper lighting level for area function.

On these pages, you see how this concept has helped to achieve

The mood is friendly in the Administration Building lobby where Day-Brite MOBILEX® fixtures, with DAYTEX® enclosures, blend smoothly with ceiling and accent modern decor . . . an example of modular lighting coordinated with the ceiling in assembly, appearance and function.

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ENDER-MONARCH SPECIFIED EXTRU-LITE FOR FIXTURES IN NEW BUILDING, *DESIGNED BY ENGINEERS FOR ENGINEERS*

Palmer & Baker's newly opened building illustrates the fine basic principles of modern lighting.

Recessed troffers (Series TWG) by Ender-Monarch Corp., Westbury, Long Island, installed on 5 ft. centers, produce 100 foot-candles throughout the 16,000 sq. ft. area of the Drafting Room, which occupies almost the entire second floor of this building.

Extru-Lite was specified as the light-controlling medium. The prismatic surface permits more light to come through; yet at the same time controls the light so evenly in both vertical and horizontal planes, that glare is removed and work surfaces are practically shadowless. It does not change the true color of the light. And despite the high levels of lighting, the low surface-brightness is kind and gentle to the draftsman's eyes.

Extru-Lite is preferred by leading fixture manufacturers, because its lightweight (a 1' x 4' panel weighs only 2 lbs.) makes for easy handling and maintenance, —thereby eliminating breakage. It is safe, too, will not shatter dangerously.

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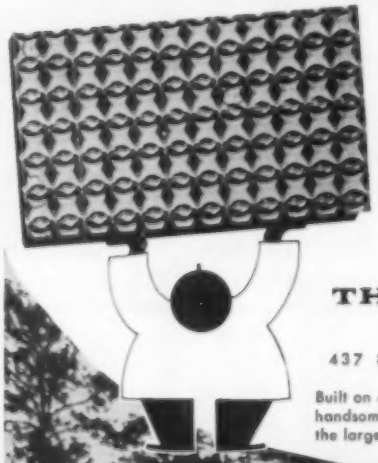

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Built on a tree-studded hill on U. S. Highway 90 in Mobile, Alabama, this handsome new building was designed by Palmer & Baker's own staff. Now the largest engineering firm in the South, they employ about 400 people.

(*Continued from page 15A*)

Atwater and Graves were Past-Presidents of IES, and Mr. Williams, who at the time was editor of *Electrical World*, had participated in various awards made by the American Institute of Electrical Engineers and other organizations. Mr. Goodell's appointment was obviously due to his having proposed the idea, but also because he was a competent and conscientious IES worker for many years.

The Committee did a thorough and efficient job. Before the administrative year ended, it presented a recommendation, unanimously approved by Council, for the adoption of the IES Gold Medal Award. The recommendation contained a design for the Medal as well as all the procedure by which it should be awarded, including the composition of the Medal Award Committee. A news story of the IES Gold Medal, illustrated with reproductions of the original pencil sketches by sculptor René P. Chambellan, appeared in the September 1943 issue of ILLUMINATING ENGINEERING.

In retrospect, it may be said that President Brown did not expect the Committee to suggest a Gold Medal for the reasons indicated above. However, the Committee found that a Gold Medal and scroll could be produced for a sum which seemed reasonable to the members of Council, one well within the Society's limited budget. There was no question that every Council member wanted to be able to present an IES Gold Medal, but there were considerable misgivings that the Society could afford such an undertaking. The Advisory Committee made it simple for Council to adopt the proposal, and the Committee deserves most of the credit for the creation of the Medal, having made a complete and sound recommendation.

The administration which created the IES Gold Medal did not have the opportunity to present it because of the time involved in making of dies once the design had been approved. Thus, the privilege and honor of presenting the first Medal, in 1944, went to Howard M. Sharp who succeeded Mr. Brown as President. Mr. Brown, however, served on the first Medal Award Committee, in accordance with the adopted procedure.

Nominations for the 1959 Gold Medal Award are being sought by this year's Committee. These nominations must be received at Society Headquarters by January 1, 1959. Candidates need not be members of the Society or citizens of the United States or Canada to qualify for the award. Any member may make a nomination by sending, to the General Secretary, the name of an individual deemed worthy of the award. — R. B. BROWN, JR., *Boston Edison Co., Boston, Mass.*

Forest City Chapter Sends Gavel to Ozark Group

Upholding the IES tradition which decrees that each Section or Chapter send to the next-formed group, a gavel made of materials indigenous to the sender's region, the Forest City (London) Chapter recently sent its gift to the Ozark Chapter on the Blackwell Report. His fashioned by a London craftsman, was made of hard maple, a tree commonly found in Southern Ontario — the maple *leaf*, of course, is Canada's national emblem. The stone hammer head mounted in the wood block was found near Rocanville, Sask., and was probably used by the Assiniboine or Sioux Indians. Hammer heads such as the one in the gavel were attached to leather thongs and used for hunting game; others were used for pounding pemican.

The next gavel presentation will be from the Ozark Chapter to the New Jersey Section.

Plan for New Chapter In Regina, Sask.

At a recent meeting of a group of 30 representative consulting engineers, contractors, utility personnel and electric suppliers in Regina, Sask., it was decided to proceed with the formation of a new IES Chapter. Present plans call for the new group to cover the entire province of Saskatchewan, now the territory of the Winnipeg Chapter. An action committee consisting of Lorne Ritenburg, Stock, Ramsey & Associates, as Provisional Chairman; and John Campbell, Saskatchewan Power Corp.; Bart Howard, City of Regina Light & Power Department; Bill Hems, Canadian General Electric Co. and H. Allan, Tibbits Electric was formed. A target date of early 1959 has been set for Chapter operation, with full cooperation and support promised from Winnipeg Chapter Chairman, Alan Burnard.

The organizational meeting was addressed by IES Director Joe Thomas who spoke on the aims and accomplishments of the Society and also outlined, in detail, the results of the recent Blackwell researches.

Prior to the Regina meeting, Mr.

(*Continued on page 22A*)

Discussing formation of a new IES Chapter in Regina, Sask. are, l. to r. in photo at left, Lorne Ritenburg, Provisional Chairman of the new group; Society Director Joe Thomas (who addressed the meeting) and Alan Burnard, Winnipeg Chapter Chairman. In photo at right, some of those who attended the organizational meeting.

NEW FIBERGLAS* POLARIZING

NEW KIND OF LIGHTING **made possible with the Fiberglas Polarizing Light Panel is ideal for offices like this. Note how panel creates a handsome ceiling effect as well.**

LIGHT DISTRIBUTION TEST: **(1)** ***Lens Panel:*** **note how light is refracted away from the direct glare zone (dark areas) to heavy beams of light in the reflected glare zone. (2)** ***Diffuser Panel:*** **note how it evenly distributes light in the reflected glare zone but leaves a concentration of light at the high angle or direct glare zone. (3)** ***Fiberglas Panel.*** **note how light is reflected away from the direct glare zone by polarizing action and is evenly distributed into a soft diffused lighting pattern.**

LIGHT PANEL!

REVOLUTIONARY PRODUCT BRINGS SOFT EVEN LIGHT WITHOUT GLARE!

Now a single panel controls the discomfort of direct and reflected glare. Fiberglas has combined the advantages of both the lens type closure and the diffuser to produce an ideal lighting panel.

WHAT IT DOES

The Fiberglas Polarizing Light Panel controls brightness by *polarization* and at the same time diffuses the light to reduce glare. It offers the two most sought after properties in lighting—the reduction of direct-from-fixture glare, which up to now has been accomplished by a lens or louver, and the reduction of reflected-from-room glare that is made possible by a diffuser. Both of these highly desirable features are now combined in the Fiberglas Polarizing Light Panel.

HOW IT WORKS

As light passes through the panel to the area directly under the fixture, thousands of tiny Fiberglas Flakes diffuse the light, making it soft and even. But as the light passes through the Flakes to the area *around* the fixture, some of the light is reflected back into the fixture by the polarizing action. This reduces light in the critical or direct glare zone 45° up to the ceiling. Result is even, glare-free light that's easy on the eyes.

HOW IT CAN BE USED

The panel is designed for use as a closure for fluorescent lighting fixtures. It's made of polyester and Fiberglas Flake and molded into flat sheet laminates. Panels are trimmed to size on order in any flat sheet size up to 24" x 48". They are lightweight, easy to ship, store, handle and fabricate. The panel's attractive textured appearance presents an interesting yet architecturally neutral effect. Panels can span a 2' x 4' area without prisms, ribs, corrugations, louvers, or supports which tend to mar ceiling continuity. Clean, flat, quiet looking ceilings are easy to design.

WHERE TO GET IT

Call your nearest Fiberglas Branch listed in the yellow pages of your phone book for complete information and data.

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(Continued from page 19A)

Thomas had addressed the Winnipeg Chapter on the Blackwell Report, and his report from Winnipeg indicates that enthusiasm is high, with a determined effort being made by the group to acquire Section status in 1959, the tenth anniversary of the Chapter.

Audio-Visual Courses in Residential Lighting Offered

A completely pre-packaged educational program in residential lighting is being offered to local public utilities by the Academy of Lighting Arts, an educational organization developed and sponsored by the General Electric Co. The course, to be conducted by the utilities, is aimed at all those who sell residential lighting equipment to the consumer including retail store personnel and electrical contractors, or those who advise the consumer on lighting such as utility personnel, interior designers and architects. The program consists of twelve 2½-hour sessions, highlighted by two 16mm sound motion pictures and ten narrated slide films. Also included in the package, which is sold for $2500, are instructors' manuals, a film projector and weekly examinations. Upon completion of the course, students are awarded "Certified Lighting Consultant" certificates.

After three pilot studies were made in Dubuque, Iowa, Cincinnati, Ohio and Newark, N. J., the Academy's program was offered throughout the country. Thus far, 21 utilities have agreed to participate in the plan.

New Dimensions for the Footcandle —Theme of Lighting Exposition

Basic theme for the National Lighting Exposition, to be held March 1-4 at the New York Coliseum, will be "New Dimensions for the Footcandle." Educational displays, a lighting clinic and manufacturers' exhibits will be keyed to this slogan, as will the 12 lectures to be delivered by leading experts from a cross-section of the lighting industry.

To date, 150 booths have been sold in the main hall, necessitating the opening of the east and west wings of the building. Last year's show featured 180 booths.

An additional feature planned for this year's Exposition is the Educational Section. Among the groups who have already decided to participate in this phase of the show are the Street and Highway Safety Lighting Bureau and NEMA's National Lighting Bureau which plans to present its "Eye Fidelity Relighting" program.

leaves from the... HISTORICAL COMMITTEE'S SCRAPBOOK

The Beginnings of Mercury Arc Lamps

Soon indeed, in the history of the developments of illuminants, do the interlacing trails of inventions grow tangled, or the memories of contemporaries become slowly dimmed in the mental mists of passing years! An outstanding example is the record of the beginning of the modern high-pressure mercury lamp and of its close relative, today's fluorescent lamp.

Few of us remember — if we ever knew — this bit of history relating to our most striking and versatile illuminants.

This story might have started with the invention of the mercury-pool electrode arc lamp, by Peter Cooper-Hewitt; its purchase and partial development by George Westinghouse, or its acquisition and substantial production at the Vapor Lamp Division of the General Electric Co., at Hoboken, during several decades roughly contemporaneous with World War I. Or it might have advanced upon the experiences with high-pressure mercury vapor lamps with mercury electrodes (The Kuech lamp, etc.) of about 1906, used chiefly in Germany. But surprisingly few inventors seem to have realized that to be successful the solid, activated (or electron-emitting) electrodes combined with automatically adjusted voltage were key features of any lamp destined to surpass the efficiency of the Nernst or the carbon-arc lamps.

But in Berlin, in 1926, Dr. Edmund Germer and two associates, Messrs. Meyer and Spanner, did disclose a patent of fundamental value which was soon assigned to the Philips Co., of Eindhoven (Germer with 50 per cent; each of the others 25 per cent ownership). This company established applications in several European countries. The idea of this novel lamp looked good, but the color seemed a handicap.

Shortly afterward, the corresponding U. S. Patent No. 2,182,732 was issued and Spanner negotiated in this country for a manufacturing concern ("Electrons, Inc.") to produce forerunners of today's fluorescent lamps, using the mercury-arc principle. Substantial contributions by Georges Claude in Paris — then working with phosphors and neon or mercury tubes — began to be noteworthy.

Spanner, associated with a Mr. Edwards (or the concern "Electrons, Inc.") convinced the American General Electric Co. that the principle was basic and portentous and, it is said, they were paid $180,000 for all U. S. rights.

This single patent became a basis for later lawsuits that the owners prosecuted; meanwhile under the Mazda cross-license plan then operative, the Westinghouse Lamp Co. shared rights to use, and to also develop, this original work of Dr. Germer and his associates.

When, years later, it became evident how valuable was this idea of solid-electrode arcs in metallic vapor, the Franklin Institute of Philadelphia awarded the Frank P. Brown Medal (October, 1954) to Edmund Germer and Hans Spanner. This award was for "The Development of the Fundamental Concept of the Fluorescent Electric Lamp, with the Accompanying Benefits of High Efficiency, Low Heat Output and Wide Color Selection."

Other good scientists — many, many of them — have perfected and extended the features of mercury arcs and fluorescent lamps over this past quarter-century, but that is another long story! Meanwhile, recognition is due these few young dreamers who, converting a kitchen of one's home into a crude laboratory and without money or large backing, opened a great window to a sky of endless lighting promise!

As the high-pressure mercury lamps began to appear (at that time more in Europe than in America), Drs. Germer and Spanner, and with aid from Herr Doering, on 7th Dec. 1929 obtained patent number G 78,165. This is noteworthy because in 1930 the ideas in this patent were developing along two paths: (a) for an illuminant and (b) for an ultraviolet sunlamp.

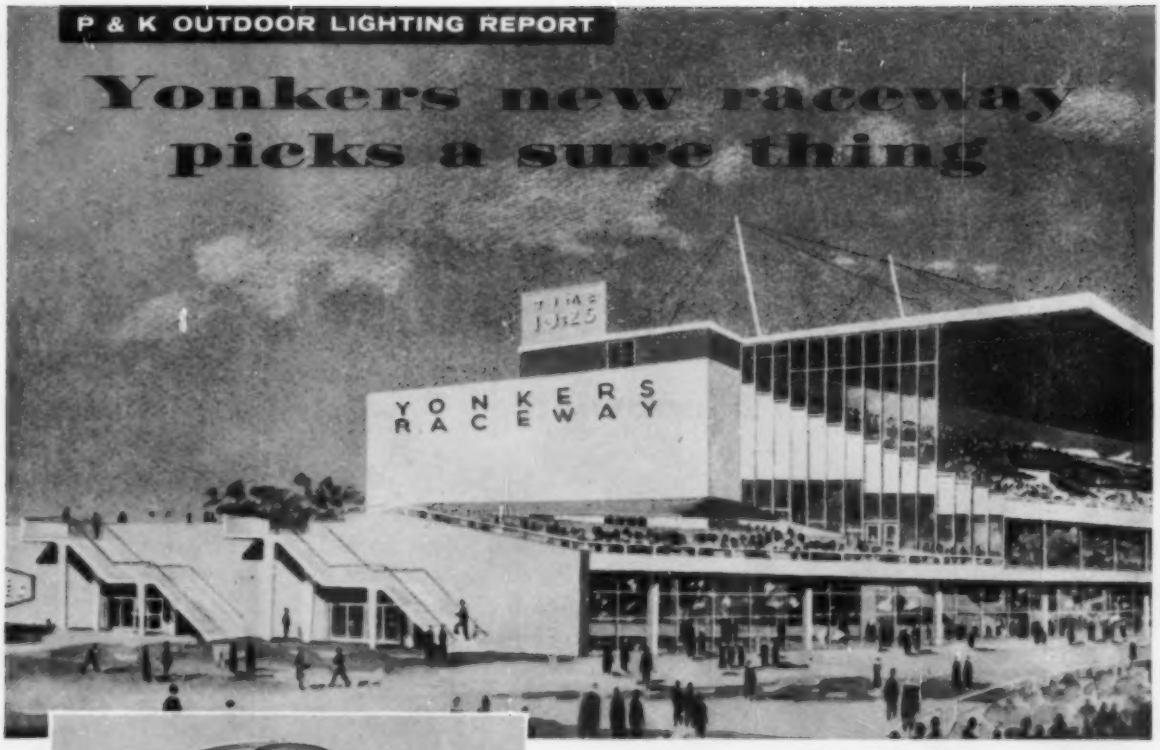
Among others, the Hanan Co. in Germany recognized the value of the ultraviolet features of mercury arcs, and made what was then termed the "Jubilee" sunlamp. This manufacturer, known today as QLG (Quartzlampen Gesellschaft M.B.H.), paid royalties under the G 78,165 patent for a long period. A like arrangement was made with the firm of Paz et Silva to manufacture sunlamps in France.

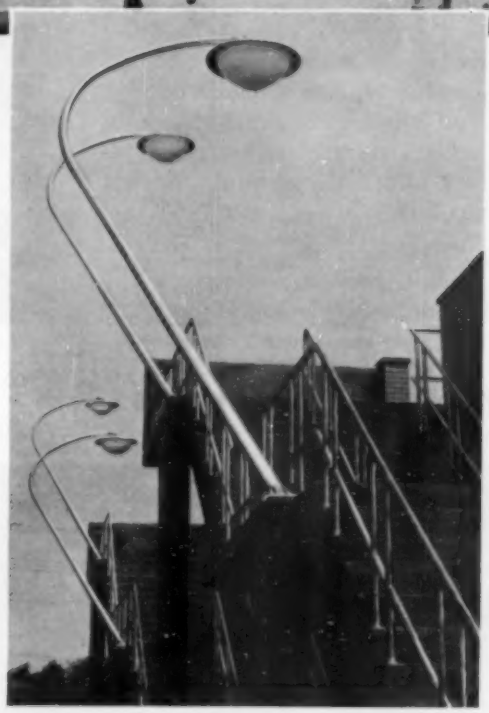
Despite troublesome times (1930-1931) in Europe, the well-known and powerful Phoebus Cartel saw values latent in the mercury illuminants, and the patentees, Germer, Spanner and Doering, were paid some 215,000 Reichmark by four leading members of Phoebus, *viz:* Osram, Philips, British Thomson-Houston, and General Electric Co. Ltd., of England.

(Continued on page 27A)

P & K OUTDOOR LIGHTING REPORT

Yonkers new raceway picks a sure thing





Architect: Lionel K. Levy, N. Y.
Electrical Consultant: Guy P. Panero, N. Y.
Electrical Contractor: Fischbach & Moore, Inc., N. Y.

P&K CIRCLElux DAVITS LIGHT THE WAY

Here, at the country's newest and most luxurious track, P&K all-aluminum CIRCLElux davit-style lighting standards were chosen. Their natural functional beauty add a modern complement to the surroundings. For example, the units illustrated are 10 foot gracefully arched davits with our CIRCLElux fluorescent luminaire. CIRCLElux incandescent luminaires were used in other applications at the raceway.

The wide range of styles available, along with the choice of three lighting sources—incandescent, fluorescent, and mercury vapor—enables you to effectively customize any installation with a "package" unit, standard and luminaire, complete and ready for installation. This means easier specifying and easier installation, and it is good to know that P&K aluminum standards never require painting or other costly maintenance, keep their good looks for years and years.

For more facts send for bulletin LTG-30 describing the complete range of CIRCLElux lighting packages.

P&K

PFAFF & KENDALL 84 FOUNDRY ST., NEWARK 5, N. J.

IN CANADA: POWERLITE DEVICES, LTD., TORONTO, MONTREAL, VANCOUVER
EXPORT REPRESENTATIVE: PHILIPS EXPORT CO., NEW YORK, N. Y.

Now... recessed "ribbons of light"

that fit all modern ceiling systems:

Sylvania's Shallow Troffer Series

in both 1-foot and 2-foot widths

NOW YOU CAN SPECIFY recessed "ribbons" of light with nearly every type and make of ceiling material used today. That's because each model in Sylvania's new Shallow Troffer Series is available with one of *three* different types of housing (see closeups below). All units are carefully engineered for quick installation with a clean, neat, light-tight fit.

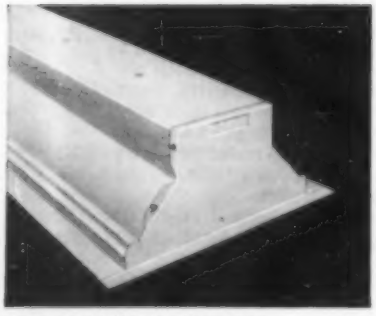
Both one-foot and two-foot widths measure only 5½" from top to bottom—slicing inches off old depths yet providing full illumination efficiency and needed heat dispersion. In many cases, no additional plenum depth is needed for mounting. Units are fully recessed. Latches and hinges don't show . . . only the clean lines of the outer framing and shielding.

In short, the Sylvania Shallow Troffer Series has a unique ability to meet many of the latest architectural requirements. It gives the creative lighting designer a new opportunity for freedom of expression, a medium for more effectively translating original decorative concepts into realities.

Lay-in type troffers are now provided for Z-spline and inverted-T ceilings. Exclusive *snap-up hanger* provides quick, secure mounting for most other types of acoustical ceilings. Contact your Sylvania Fixtures Specialist for further details. Or write to Lighting Headquarters for folder V-700 with complete specification data.

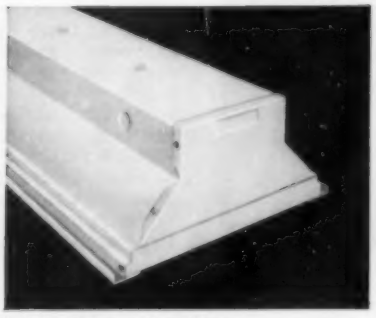
SYLVANIA ELECTRIC PRODUCTS INC.
Dept. L30, Lighting Division—Fixtures
One 48th Street, Wheeling, W. Va.

All it takes are these 3 Sylvania housing types



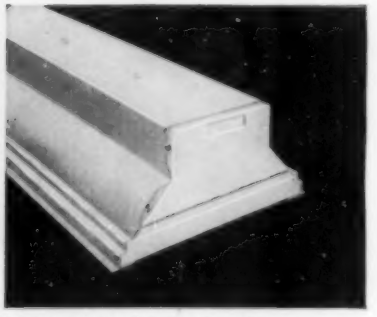
Exposed Flange Housing

For most acoustical tile and plaster ceilings. For appearance, wide side flanges and flange-type end caps trim the ceiling opening. Choice of Snap-Up Hanger, Hanger-Strap, or End-Support Bracket Mounting, depending on ceiling type.



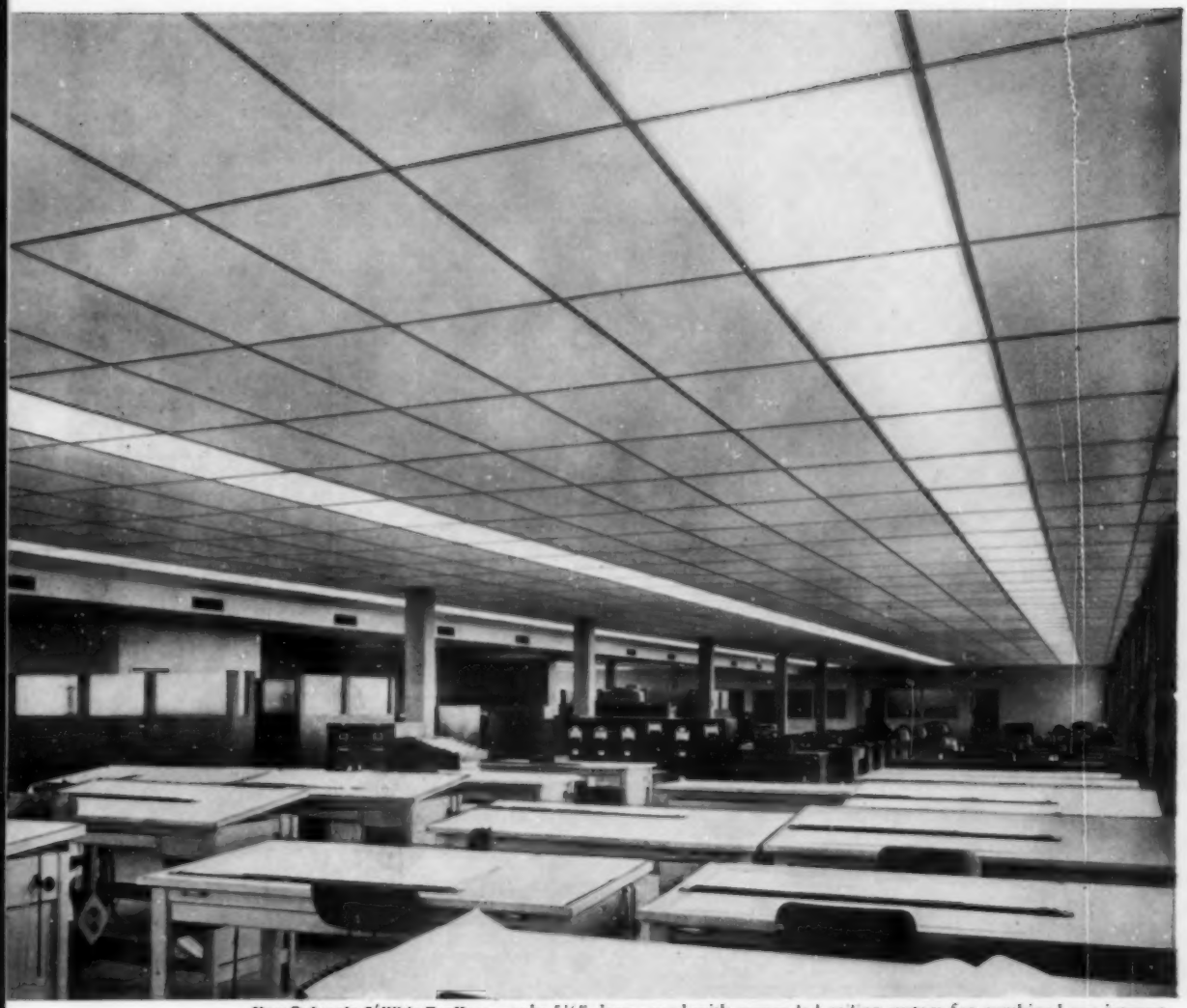
Fit-in Flange Housing

For use with metal pan acoustical ceilings. Has straight ends for proper functioning of metal pans. To facilitate installation, turned-up lips do not actually engage in the T-bar, but *do* provide appearance of complementing metal pan.

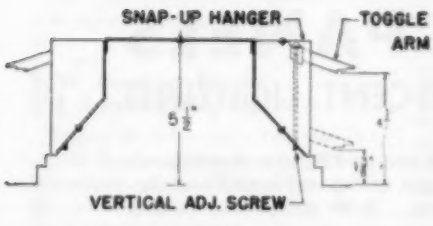


Concealed Flange Housing

For inverted T-grid acoustical ceilings. Used with Inverted-T acoustical ceilings or exposed Z-Splines running parallel to troffers, it always employs Lay-In mounting. Narrow side flanges, "cut-back" ends fit modular ceiling dimensions.



New Sylvania 2′ Wide Troffers—only 5½" deep—used with suspended ceiling system for combined eye-interest and good lighting. Shown: the new offices of Hagan Chemicals & Controls, Inc., Parkway West, Pittsburgh, Pa.



5½" high troffers utilize full plenum space

Exclusive new Snap-Up Hanger eliminates wasted plenum depth; toggle springs out, rests on ceiling supports when fixture is pushed into position. Leveling is accomplished with adjusting screw.

Easy access cuts maintenance time, costs

Simple push upward releases hidden latch. Concealed hinging swings shielding down, holds it throughout cleaning and lamp changes. Each fixture is individually fused.

Sylvania's standard troffer shieldings include—

Corning #71 Crystopal Flat Glass Lens
Corning Flat Albalite (diffuse opal glass)
Skytex
Patterned Clear Plastic Lens
Dished Acrylic Plastic (diffuse panel)
Plastic Louver—43° x 43°
Metal Louver—35°C x 45°L
Metal Louver—45°C x 45°L

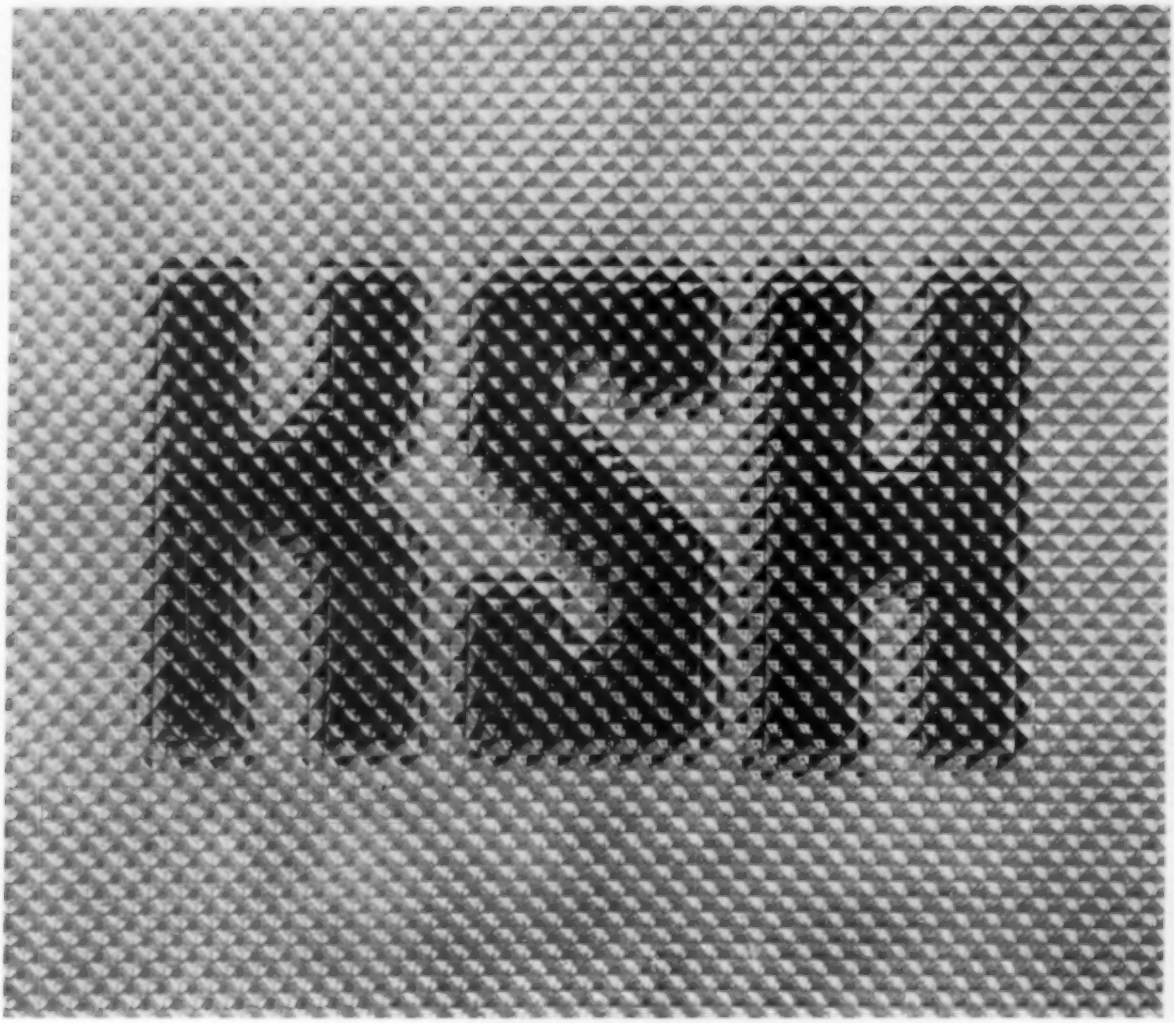
Other shielding types will be provided on request.

Best fixture value in every price range

SYLVANIA

Fluorescent Lighting Fixtures and Systems

LIGHTING • TELEVISION • RADIO • ELECTRONICS • PHOTOGRAPHY • ATOMIC ENERGY • CHEMISTRY-METALLURGY



K LITE *

PRISMATIC LENS PANELS

FOR CREATIVE MODULAR FLUORESCENT LIGHTING

KSH now extrudes prismatic lens panels for the ultimate in *LOW BRIGHTNESS* and *LOW GLARE RATING*, in standard patterns and in special patterns as desired. These panels are available either in acrylic or clear polystyrene with improved light stability.

* New available in K-2, K-3, K-4 patterns.

CALL YOUR nearby KSH executive-engineer for on-the-spot service and helpful engineering decisions . . . both indoor and outdoor lighting.

- Atlanta, Ga.
- Chicago, Ill.
- Dayton, Ohio
- Detroit, Mich.
- Grand Rapids, Mich.
- Indianapolis, Ind.
- Los Angeles, Calif.
- Milwaukee, Wisc.
- St. Louis, Mo.
- Salem, Mass.

KSH PLASTICS, INC. HIGH RIDGE, MISSOURI

(Continued from page 22A)

Substantial royalties were paid until 1950, except as war interfered. By 1932, Osram installed prototypes of today's A-H1 mercury lamps (hard glass arc tubes) in Berlin, and by 1934 these lamps were not unusual in England. Dr. Germer's dreams were coming true.

By 1933, not being offered a "suitable sum by any American manufacturer for a license, there was established a small maker known as the Spanner Vapor Co." that placed a few lamps chiefly in New York City.

At that period the sunlamp feature seemed the leading one, and the Hanovia Chemical Co., of New Jersey, purchased a license for this, similar to Q.L.G. in Germany. These therapeutic lamps, also the blueprinting vapor tubes, were and are made largely under the German patent number 2,202,199.

By 1939, the American General Electric Co. secured rights to manufacture the mercury illuminants and offered to pay something in excess of $262,000 for the patent. But suddenly war stopped all business exchanges. Just where the Alien Property Custodian impounded this money is yet another story.

It did not seem advantageous for Hanovia to grant a sub-license to Westinghouse (who had also some electrode developments of value) but after winning a suit over the matter of activated electrodes, Westinghouse proceeded to manufacture in substantial volume, favoring the quartz arc tube instead of glass.

Today the hundreds of patents and the more than 50 varieties of mercury vapor arcs, making up a total of some 8,000,000 lamps sold in the United States annually (many also throughout the world) attest to the great credit due these early inventors and to the devotion of hosts of subsequent scientists who have developed and applied the mercury vapor (and companion metallic vapor) arcs for man's expanding uses.

E. W. Commery Retires G-E Home Lighting Expert

Eugene W. Commery, a Fellow of IES, retired October 1 from the Large Lamp Department of the General Electric Co. Mr. Commery was supervisor of residential lighting applications.

Internationally known as an authority on home lighting standards, he is the author of "See Your Home in a New Light," published by General Electric, and co-author, with C. Eugene Stephenson, of "How to Decorate and Light Your Home," published by Coward-McCann, Inc., in 1955. He has spoken extensively across the United States and Canada and, in 1952, addressed the annual technical meeting of the Association Francaise des Eclairagistes in Toulouse.

Eugene W. Commery

Mr. Commery, who joined the Society in 1922, has served it as chairman and member of many of its technical committees and has been the IES representative to the Inter-Society Color Council. He has presented, and published in ILLUMINATING ENGINEERING, numerous papers at IES National Technical Conferences. In 1950, he was elevated to the grade of Fellow of the Society, and at the 1958 National Technical Conference, just preceding his retirement, a special Citation of Achievement was awarded to him.

He is a representative on the United States Committee of the International Commission on Illumination assigned to study and report on television. He was active in the formation of the Better-Light-Better-Sight Bureau and in developing the lighting for the New York World's Fair Houses in the Town of Tomorrow.

Following his retirement, Mr. Commery and his family are taking up residence in Key Biscayne, Fla.

Science Library to Circulate In U. S. Secondary Schools

The American Association for the Advancement of Science and the National Science Foundation, together with United States book publishers, will provide about 1400 of the country's senior high schools with a circulating science library during the current school year. Approximately 350 libraries, each composed of 200 books will be available, as a result of a $500,000 grant to the AAAS from the National Science Foundation.

Fifty books will be sent to a school at a time, with an exchange to take place every two months, so that during the year each school will receive a complete set of books.

The program, which is now in its fourth year, began with 11 sets of 150 books, circulated to 66 schools.

Plastics Standards Group Holds Meeting in Washington

Washington, D. C. was the scene of an international plastics standards meeting on November 3-8. Delegates from 20 countries attended the meeting, conducted by Committee 61 of the International Organization for Standardization.

Responsibility for United States technical participation in the conference rested with Committee D20 on Plastics of the American Society for Testing Materials. On behalf of U. S. interests, the American Standards Association held the secretariat for the project.

ABOUT PEOPLE

Dr. **Robert S. Wiseman** was recently named Chief of the Warfare Vision Branch of the U. S. Army Engineer Research and Development Laboratories, Fort Belvoir, Va. This promotion follows, by only a few months, his appointment as assistant branch chief. **Benjamin Goldberg,** former head of the Warfare Vision Branch is now serving as chief of another branch of the Laboratories' Electrical Engineering Department. The Laboratories are the principal field agency of the Corps of Engineers for the research and development of new materials, methods and techniques for military operation.

Pittsburgh Reflector Co. has announced that **Leroy Ward,** formerly superintendent of the company's Irwin, Pa. plant, has been named director of Standardization and Tooling. This change is designed to implement a broad program of product development and mass production. Replacing Mr. Ward as plant superintendent is **Donald M. Fink.** Both men have been associated with Pittsburgh Reflector for many years, serving in various managerial positions.

Roger J. Delander, former western regional manager for Sylvania Electric Products — Fixture Division, has been named general sales manager of the Leadlight Fixture Co., Oakland, Calif. He will make his headquarters at the company's home office in Oakland.

Two appointments in the commercial engineering division of the Westinghouse Large Lamp Department, Bloomfield, N. J., have been announced by **Marshall N. Waterman,** commercial engineering

(Continued on page 28A)

RETIRING after 40 years of service in Lighting Sales Dept. of Corning Glass Works is Harry T. Wharton (center). Admiring the engraved Steuben crystal urn presented to Mr. Wharton at his retirement banquet are Percy Saxton (left) of Cleveland and Arthur S. Tylor of San Francisco.

(*Continued from page 27A*)

manager. **Thomas S. Madonia** will direct fluorescent lamp commercial engineering and **William S. Till** will be in charge of commercial engineering activities for mercury lamps. Both men will have their offices in Bloomfield.

Appointment of **E. A. Fargis** as regional sales manager, with headquarters in Atlanta, Ga., has been announced by Smitheraft Lighting, Chelsea, Mass. Mr. Fargis had been associated with the Noland Co., independent Southern electrical distributors, for 22 years, most recently as assistant general manager of the electrical department. In his new position with Smithcraft, Mr. Fargis will supervise sales activities in Virginia, North and South Carolina, Georgia, Florida, Tennessee, Alabama, Louisiana, Mississippi, Arkansas, Texas and Oklahoma.

Fluorescent Fixtures of California has announced the addition of **Charles D. Mills, Jr.** to its sales and engineering staff. Mr. Mills will serve as special assistant to **Milt Very**, Southwest sales engineer, in servicing the Texas and Louisiana territory in the distribution of the All-Brite line.

Hugh P. Scott has been named Associate Editor of *Electrical Construction and Maintenance*, a McGraw-Hill publication. In this new position, Mr. Scott will be responsible for reporting activities in the fields of lighting and power distribution and control occurring in the 12 western states. Mr. Scott, who had been Industrial Editor of EC&M in New York for the past 12 years, now has his headquarters at 68 Post St., San Francisco, Calif.

Ronald A. Giles of Indianapolis has been signed as Indiana sales representative by the Quadrangle Manufacturing Co., Chicago, Ill. Prior to this connection, Mr. Giles was a manufacturers' representative for the Minnesota Mining Co.

Transfer of **Gerard W. Kolling, Jr.** to Portland, Ore. where he will serve as district manager, has been announced by the Union Metal Manufacturing Co. Mr. Kolling was formerly located at the company's main offices in Canton, Ohio. Also announced by Union Metal was the appointment of the Taper Tube Co. of San Francisco, headed by **Clinton deWitt, L. F. Krusi, C. G. Strom** and **J. L. Wrathall,** as sales representatives in northern California and northern Nevada.

J. Stanford Smith has been named general manager of the General Electric Co. Outdoor Lighting Department in Hendersonville, N. C., effective November 1. Mr. Smith was formerly manager of public and employee relations communications for the company, with headquarters in New York City.

Crouse-Hinds Co., Syracuse, N. Y., has announced several recent changes in its sales department. **W. C. Schafer** of Seattle, Wash. has been promoted to the position of San Francisco regional manager, with headquarters at 370 Brannan St., succeeding **W. R. Major, Jr.** who has been transferred to Atlanta, Ga. Product engineer, **W. G. Bullock,** has been transferred from Los Angeles to Seattle replacing Mr. Schafer. Current product engineer for the Los Angeles region is **John M. Adams** who has made a transfer from New York.

Merrill E. Skinner, vice-president and director of sales for Union Electric Co., St. Louis, has been awarded a special resolution of appreciation "in recognition of his outstanding service and leadership in the development of National Electrical Week." Mr. Skinner, as representative of the Edison Electric Institute served as the committee's first national chairman, from 1955 through the 1958 observance of NEW.

Kirlin Co., Detroit, Mich. has announced the appointment of **Bert L. Trapani** as sales representative for the Georgia territory.

Deaths

T. J. Connell, Southeast Florida Section.
George J. Ellis, Mid-South Chapter.
C. D. Fawcett, Philadelphia Section.
Robert T. Lattin, Michigan Section.
C. E. Mertens, Montreal Section.

BOOKS AND PAMPHLETS

*Books whose reviews are marked * are available for inspection at IES Headquarters, Technical Office.*

***Home Builders Manual** for Land Development, published by the National Association of Home Builders, 1625 L St., N.W., Washington, D. C. Paper bound, 264 pages. $5.00. Illustrated.

The second revised edition of the Land Planning Manual, this book covers such subjects as site considerations, utility systems, lot planning, and street layout.

American Standard C89.1-1957, Requirements and Terminology for Specialty Transformers, published by the American Standards Association, 70 East 45th St., New York 17, N. Y., 46 pp., $2.50 per copy.

This publication, sponsored by the Specialty Transformer Section of the

(*Continued on page 31A*)

BRINGS YOU AMERICA'S NEWEST MOST COMPLETE LINE OF 24" TROFFERS

192 DIFFERENT SIZES and TYPES

Designed and engineered to make Troffer selecting simple, easy and foolproof

This single troffer line will answer almost any recessed fluorescent lighting problem. No matter how you wish to design, control or utilize illumination an L.P.I. Variform 24" troffer will give you these outstanding advantages.

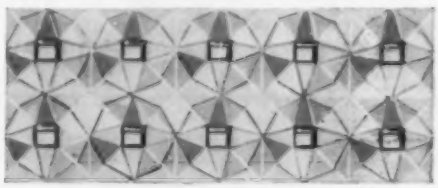
1. **MODULAR**—2'x2' and 2'x4' units
2. **LAMPS**—2, 3 or 4, 24" or 48"
3. **RECESSING**—Flush, snap-in, lay-in or flange for all types ceilings.
4. **LIGHT CONTROL—6 DIFFUSERS**—Polystyrene egg-crate, No. 70 Corning, Albalite, Pattern formed Vinyl, Plain formed Acrylic, and Ventrolens.

FREE **ORDERING DATA-CEILING CHART**

a reference guide that permits instant selection of the correct style troffer to properly fit any of more than 60 different types of ceiling construction of leading manufacturers. Eliminates guess-work, compromise and costly errors in ordering. Write for your copy today.

Featuring the Amazing *New* VENTROLENS

This new exclusive L.P.I. lens diffuser is as functional as it is beautiful. Made of .135" light stabilized polystyrene with an exterior surface of .200 octagonal prisms, it has exceptional low-brightness control with high efficiency. Write for sample.



PLAN VIEW

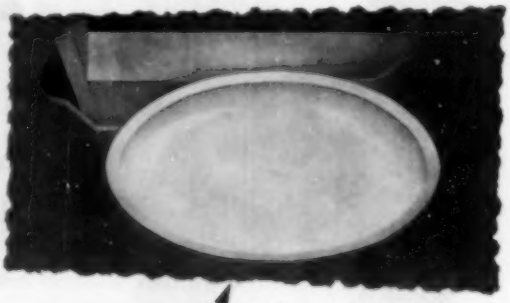
CROSS SECTION

lighting products inc. DEPT. 6M HIGHLAND PARK, ILL.

YOU CANNOT MISS

In your aim to obtain better lighting for better vision you will get a bull's-eye every time that you specify or select Sunbeam Lighting. Your chances of direct hits are greatly enhanced by the following factors: 1. All Sunbeam Visionaires® are designed, engineered and test-proven to produce specific illumination results. 2. You can choose from the largest line of quality luminaires in the country for almost every commercial, institutional and industrial application. 3. Two complete manufacturing facilities are strategically located to provide rapid, nation-wide deliveries. Typical of the many modernly styled and easy to install fixtures are the SHALLORAMA®, SIGHTLINE® and CSP3800 Visionaires®

Specify SHALLORAMA® for new or remodeled interiors, especially in low ceiling areas. They look recessed. The Plexiglas diffuser is guaranteed for 15 years.



Select the "large-area" circular, recessed #CSP3800 Visionaires for architectural contrasts. Domed Plexiglas enclosed in inset trim.

Recommend SIGHTLINE® for the ultimate in comfortable, glare-free illumination. A totally indirect lighting system that blends with the ceiling. Ideal for critical seeing areas.

SUNBEAM visionaire LIGHTING DESIGNS

Sunbeam Lighting Company, 777 East 14th Pl., Los Angeles 21, California

Gary, Indiana

(Continued from page 28A)

National Electrical Manufacturers Association and National Standards Committee C89, includes standards of ratings, dielectric strength, losses and impedance, regulation, temperature rise, construction, marking, service conditions and definitions. It is recommended for use in conjunction with American Standard C-33.4-1958, Safety Standards for Specialty Transformers ($1.00), developed by the Underwriters' Laboratories.

Both publications are available from Dept. PR 20 of the American Standards Association.

NEW MEMBERS

At the meeting of the I.E.S. Council Executive Committee on October 9, the following were elected to membership. Names marked * are transfers from Associate Member Grade. Names marked ** are transfers from Student Member Grade.

ALABAMA SECTION

Associate Member:

Galloway, J. E., Knight Electric Co., Birmingham, Ala.

ARIZONA SECTION

Associate Members:

Brown, B. M., Bernard Brown Light Maintenance Co., Phoenix, Ariz.
Buckles, H. W., Arizona Public Service Co., Phoenix, Ariz.
Hamby, A. E., Motorola Inc., Phoenix, Ariz.
Walker, R. L., Arizona Public Service Co., Phoenix, Ariz.

BRITISH COLUMBIA SECTION

Associate Members:

Hara, J. F., Line & Cable Accessories Ltd., Vancouver, B. C.
Kingsley, E. J., W. Freeman & Son Ltd., Vancouver, B. C.
Macdonald, William, Canadian Westinghouse Co., Vancouver, B. C.
Marshall, D. A., Amalgamated Electric Corp. Ltd., Vancouver, B. C.
Rawlings, D. G., W. Freeman & Son Ltd., Vancouver, B. C.
Shore, R. C., W. Freeman & Son Ltd., Vancouver, B. C.

CAPITAL SECTION

Members:

*Bailer, E. F., General Electric Co., Washington, D. C.
Reinsmith, H. G., Government of the District of Columbia, Washington, D. C.

Associate Member:

Marshall, R. C., Robert C. Marshall Ltd., Washington, D. C.

CENTRAL ILLINOIS CHAPTER

Associate Members:

Conzelman, A. E., Central Illinois Light Co., Lacon, Ill.
Gongwer, Carolyn J., Central Illinois Light Co., Peoria, Ill.
Randall, Richard, Sylvania Electric Products Inc., St. Louis, Mo.
Sellers, W. D., Westinghouse Electric Supply Co., Peoria, Ill.

CENTRAL NEW YORK SECTION

Associate Members:

Thomas, H. R., Thomas Electric Co., Cortland, N. Y.
Tichane, R. M., Corning Glass Works, Corning, N. Y.
Wilson, W. C., 103 Castle, Geneva, N. Y.

CENTRAL OKLAHOMA CHAPTER

Member:

*Sheline, P. R., Paul Sheline Co., Oklahoma City, Okla.

Associate Member:

Dane, B. J., Osborne Electric Co., Oklahoma City, Okla.

CHICAGO SECTION

Members:

Bennan, E. J., Jefferson Electric Co., Bellwood, Ill.
Kempf, V. T., 194 Edgemond Lane, Barrington, Ill.
*Riley, John H., Jack Riley Associates, Chicago, Ill.

Associate Members:

Johnson, M. C., Samco, Inc., Chicago, Ill.
Ley, Theodore, Advance Transformer Co., Chicago, Ill.
Thompson, I. A., 1018 Cleveland Ave., Elkhart, Ind.

CHINOOK CHAPTER

Associate Members:

Cornish, G. H., City of Calgary, Calgary, Alta.
Venable, R. E., Canadian General Electric Co., Calgary, Alta.

CLEVELAND SECTION

Member:

Underwood, P. J., General Electric Co., Nela Park, Cleveland, Ohio.

Associate Members:

Adams, J. C., General Electric Co., Cleveland, Ohio.
Bishop, J. G., Sylvania Electric Products Inc., Cleveland, Ohio.
Potter, D. R., 752 Nome Ave., Akron, Ohio.

COASTAL BEND CHAPTER

Associate Member:

Benson, Mrs. Virginia, Central Power & Light Co., Sinton, Texas.

COASTAL EMPIRE CHAPTER

Member:

Maddox, J. A., 409 E. 54 Lane, Savannah, Ga.

CONNECTICUT SECTION

Members:

Hill, F. M., 909 Whalley Ave., New Haven, Conn.
Liberi, M. W., The Superior Electric Co., Bristol, Conn.

Associate Members:

Mueller, J. F., 15 Lewis St., Hartford, Conn.
Strong, D. S., Wheeler Reflector Co., R.F.D. 3, Coventry, Conn.
Van Houten, R. L., Marchand & Mingee Engineers, West Hartford, Conn.

CORNHUSKER SECTION

Member:

Rathbun, I. T., Carl A. Goth, Omaha, Nebr.

Associate Members:

Ridgeway, T. E., Mfg. Sales Agency, Omaha, Nebr.
Schulte, W. E., Omaha Public Power Dist., Omaha, Nebr.
Semerad, G. E., 718 Barker Bldg., Omaha, Nebr.

EASTERN NEW YORK SECTION

Associate Members:

Farnam, John, Adequate Wiring Bureau, Albany, N. Y.
Hussey, R. F., Niagara Mohawk Power Corp., Albany, N. Y.

EASTERN PENNSYLVANIA SECTION

Member:

*Mott, R. J., Electro Silv-A-King Corp., Reading, Pa.

FOREIGN NON-SECTION

Members:

*Beuttell, A. W., Linolite Ltd., The Mill Works, Malmesbury, Wiltshire, England.
Garcia, V. M., 1357 Ponce De Leon Ave., Santurce, Puerto Rico.

Associate Members:

Arabian, M. V. General Electric De Venezuela, Caracas, Venezuela.
Bonin, F. M., 710 Normandie Court, 94 Kerk St., Johannesburg, Transvaal, S. A.
Couturier, R. C., Compagnie Des Lampes, 29 Rue De Lisbonne, Paris, France.
Gangla, N. S., MSVY & Co. Private Ltd., Bombay, India.

(Continued on page 32A)

1959 Regional Conferences — I.E.S.

Region	Place	Date
East Central	Lord Baltimore Hotel Baltimore, Md.	April 9-10
South Central and Southeastern	Grove Park Inn Asheville, N. C.	April 23-24
Southwestern	Shamrock-Hilton Hotel Houston, Texas	May 4-5
Midwestern	Pere Marquette Hotel Peoria, Ill.	May 6-8
Inter-Mountain	Continental Hotel Denver, Colo.	May 11-12
Pacific Northwest	Banff Springs Hotel Banff, Alta.	May 26-30
Northeastern	Curtis Hotel Lenox, Mass.	June 4-5
Canadian	Chateau Laurier Ottawa, Ont.	June 11-12
Great Lakes	Statler Hotel Buffalo, N. Y.	June 22-23

REGISTRATION for the Mid-South Chapter's Fundamentals Course being conducted by Glenn McMullen (seated). Forty-seven students signed up for the course which is being held at the offices of the Memphis Park Commission.

(*Continued from page* 31A)

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(*Continued on page* 50A)

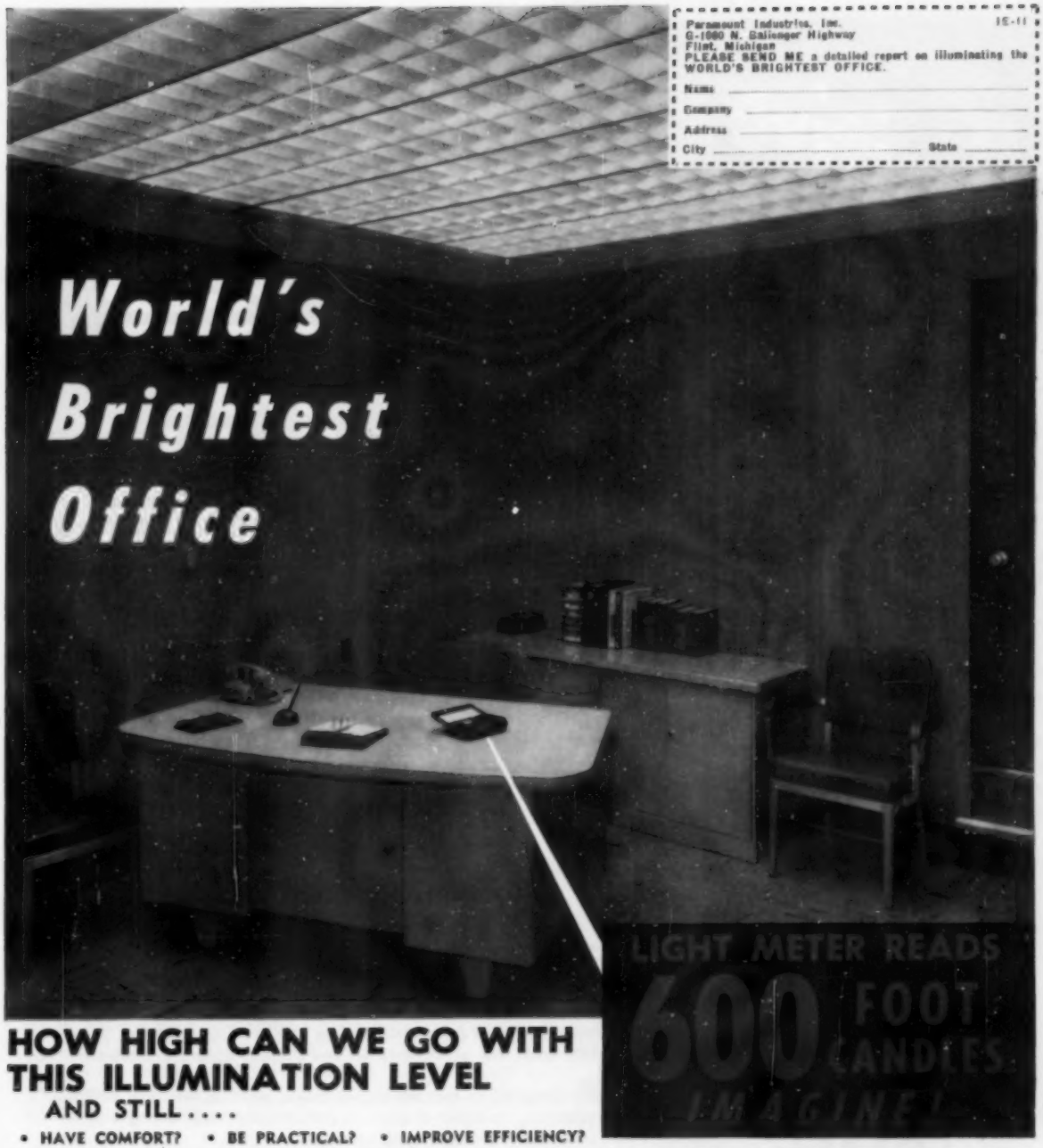
I.E.S. National Technical Conferences

1959 — September 7-11 — Hotels Fairmont and Mark Hopkins, San Francisco, California

1960 — September 11-16 — Penn Sheraton Hotel, Pittsburgh, Pennsylvania

1961 — September 24-29 — Chase Park Plaza Hotel, St. Louis, Missouri

1962 — September 9-14 — Statler-Hilton Hotel, Dallas, Texas



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with
QUAD
EASY
TACH
IN SECONDS
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TURN 2
1 UP
1. Simply push the pronged socket up into the cast hood. 2. Turn clockwise and you have instant mechanical and electrical connection.
DISCONNECT JUST AS EASILY
3 TURN
OFF 4
2 UP
1 TURN
1. Grasp the reflector lightly and turn counter-clockwise, 2. A slight pressure upward unlocks the socket and . . . 3. then rotating the reflector counter-clockwise, 4. a slight downward motion removes the reflector.
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(1) I.E.S. LIGHTING HANDBOOK

I.E.S. LIGHTING HANDBOOK

THIRD EDITION

See Page 1A

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The Publications of the Illuminating Engineering Society listed here summarize the vast amount of research, investigation and discussion of hundreds of qualified members of the Society working on technical committees. Each publication listed here is supported by the full authority and approval of the Illuminating Engineering Society.

I.E.S. Publications are available, in single copies or in bulk, to anyone requiring knowledge of the newest in lighting application and the supporting technical information. Should quantities be desired for distribution, such as for educational or promotional purposes, prices may be obtained by writing Publications Office.

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I.E.S. RECOMMENDED LIGHTING PRACTICES

These booklets are the complete, standard recommendations for lighting the prescribed areas, and are among the most comprehensive and important of all Society publications. As indicated, some of these recommendations are the work of committees of the American Standards Association, with collaboration by appropriate committees of the I.E.S. All have the approval of the Council of the Illuminating Engineering Society, and are the latest official I.E.S. recommendations.

In general, the information contained in these Recommended Lighting Practices covers completely the area shown in the title. Included in the data are suggested types of lighting systems and luminaires; levels for general lighting and for specific areas; analyses of seeing tasks; and other information essential to lighting the area and of value to lighting engineers and specialists, architects, construction people and others. Each practice is fully illustrated with charts and photographs.

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I.E.S. Recommended Practice 32 pp. 50c

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RP-11 RESIDENCE LIGHTING
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I.E.S. COMMITTEE REPORTS

Lighting recommendations based upon studies (research, surveys of current practice, and experimental installations) of I.E.S. Committees and Subcommittees covering all phases of lighting. Completely illustrated, these reports contain detailed information on many lighting problems peculiar to the industry or operation involved as well as providing general data as to lighting systems and luminaires; recommended quantity and quality of illumination; and analyses of specific seeing tasks.

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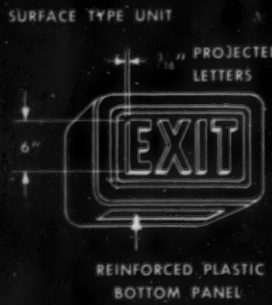

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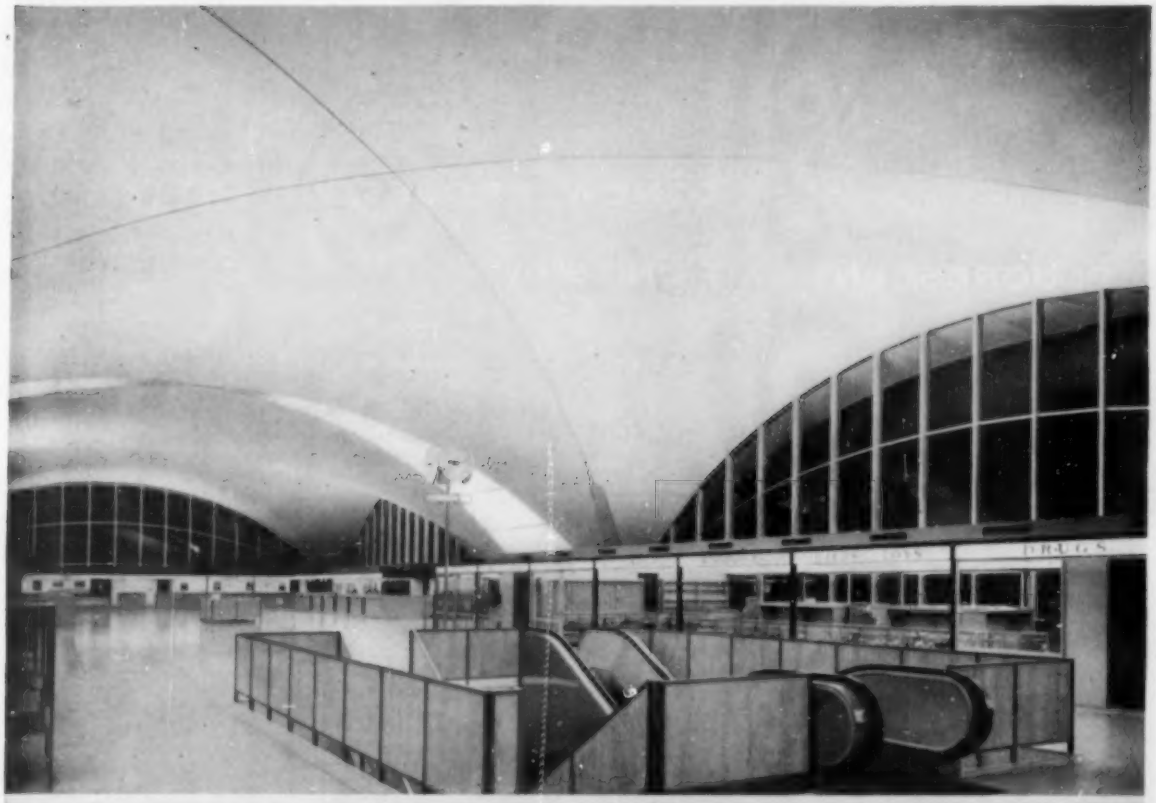

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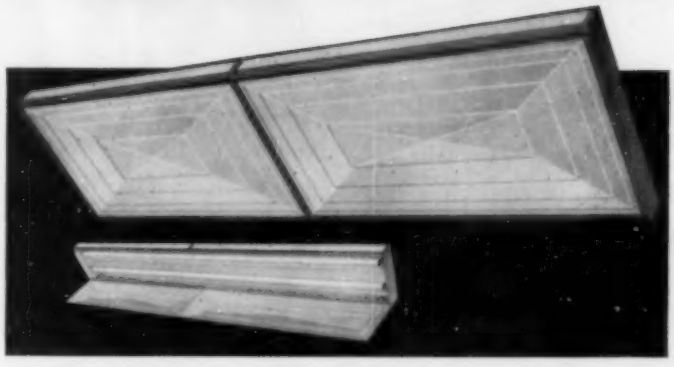
FOR SHOW!

The shallow BOSTON Series makes a neat, clean-cut appearance. Less than 4" deep. Plastic louver or vinyl lens completely framed; hinged at both sides for quick relamping. Rigidly framed plastic sides cannot curl or warp. Available in 4′ or 8′ lengths for 2 or 4 lamps.



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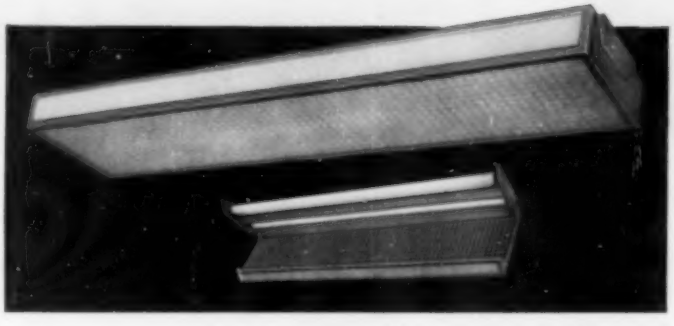

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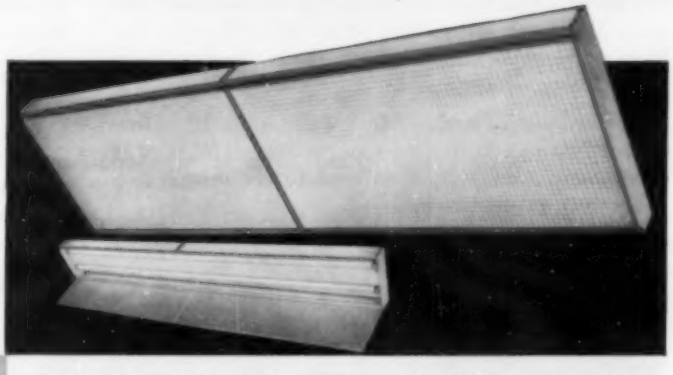

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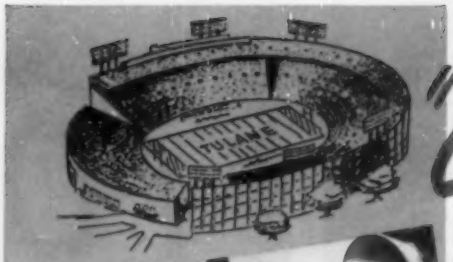
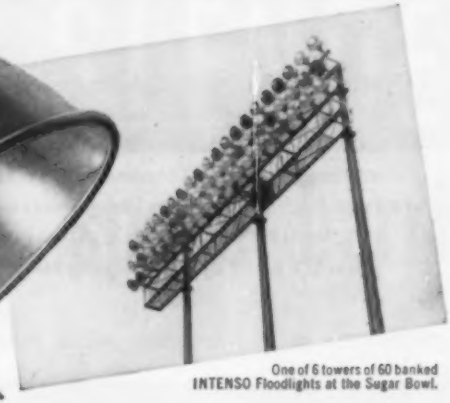


Workmen at Sugar Bowl checking INTENSO light before bank is raised to lower height.

Photos courtesy of Tulane University

Mario Zarvigno and Associates, Consulting Engineers

Opens for Split-Second Rear Relamping



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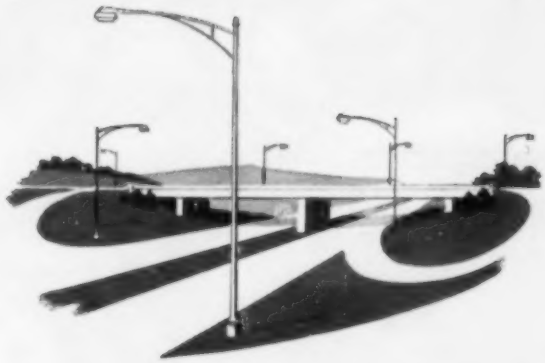
"Eagle Claw" Switch Boxes

for street lighting • highway lighting • floodlighting

UNION METAL MONOTUBE POLES

Monotube street lighting poles . . . steel or aluminum . . . round or fluted . . . davit or bracket styling . . . anchor or transformer base. Attractive in any location. Continuous-tapered Monotube poles are available in a broad range of designs and sizes to meet all requirements.

Monotube highway lighting poles are offered for various mounting heights and strength requirements. Easily wired and installed. Steel Monotubes are made from high grade, open hearth steel and cold-rolled for strength. Aluminum poles are made by the spinning method.



Monotube floodlighting poles . . . for sports, business, industrial or recreational areas. Available in heights from 20 to 100 feet. Monotube designs permit extreme flexibility in arrangement and number of light units per pole. Floodlights can be mounted, positioned and wired while pole is on the ground.

Complete design and specification data is readily available upon request. Write The Union Metal Manufacturing Company, Canton 5, Ohio. In Canada: The Union Metal Manufacturing Company of Canada, Limited, Brampton, Ontario.

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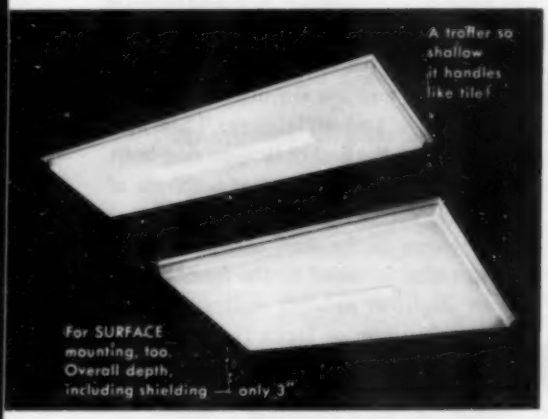
Monotube Lighting Poles

NEW Smithcraft SLENDEX

breaks the ceiling space barrier



BREAKS THE CEILING SPACE BARRIER! 100 SLENDEX 2' x 4' units, selected from the offerings of 14 manufacturers, installed in the testing laboratory of one of the nation's largest steel companies. Ceiling 7'6" at lowest point; 1½" cavity depth.

SLENDEX solves tough ceiling problems . . . in acute ceiling space conditions . . . in low ceilings . . . in minimum cavities. Recesses only 1⅜" . . . SLENDEX is so shallow it handles like tile! Slender, sleek architectural styling is complemented by unique engineering features. Requires no extra depth for tilting . . . goes into the ceiling *flat*. Simplified installation and maintenance. Clean uniform lighting . . . no dark center streaks. Now — simplify your lighting job by using the new Smithcraft SLENDEX!

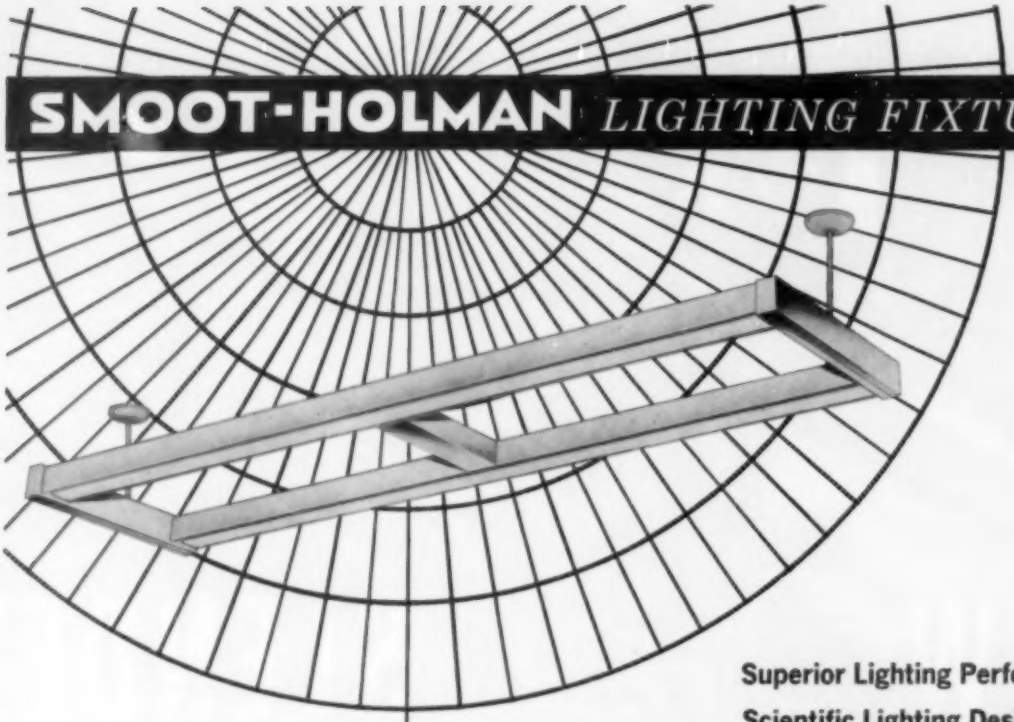
ADAPTS TO ALL COMMON CEILING TYPES

Inverted "T" grid systems
T-bar ceiling with snap-in metal pans
Plaster ceilings supported by wood furring
Soft tile ceilings with Z-spline, nail lock, or similar devices.

Write today for the complete Smithcraft Catalog, your buying guide to "America's finest fluorescent lighting."

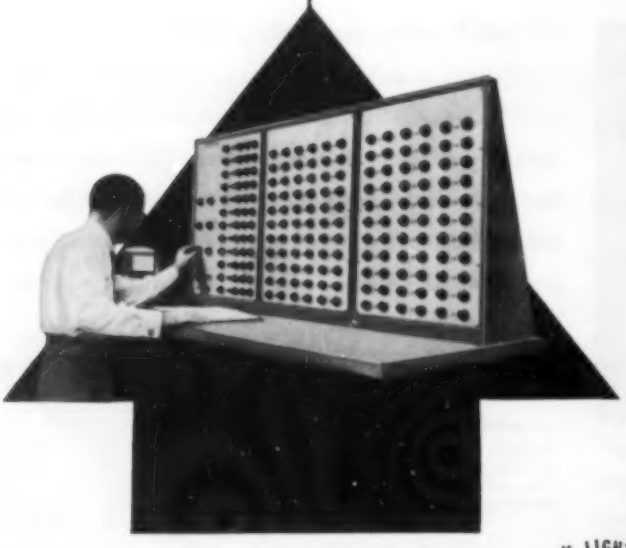
Smithcraft
LIGHTING
CHELSEA 50, MASSACHUSETTS

SMOOT-HOLMAN *LIGHTING FIXTURES*



Superior Lighting Performance!
Scientific Lighting Design!

MADE POSSIBLE BY THE NEW SMOOT-HOLMAN ANALOGUE COMPUTER!



Through the use of an advance design, analogue computer, Smoot-Holman research engineers are now able to design fixtures that give superior performance and are the ultimate in construction and efficiency. This new computer, the first of its type ever built for commercial use, solves problems of fixture design, as well as many other problems in the field of lighting. It's operation is based on the formation of an electrical network analogue of the distribution of light flux. Here is another example of Smoot-Holman's research and development to bring you *"Tomorrow's Lighting Today."*

SMOOT-HOLMAN COMPANY

Inglewood • California

Kopp *engineered glass*

opens new vistas in product design and performance

Developments in glass and lens technology open new design possibilities for many products. To help you get maximum value from your glass components, Kopp offers the services of an organization highly skilled in the design and manufacture of engineered glass products that are required in relatively small production quantities. Here extensive modern laboratory equipment permits research into all phases of light and color transmission, beam control, thermal shock resistance, high temperature effects, dimensional stability, mechanical strength. Manufacturing "know-how" produces high quality parts of dependable uniformity. Long experience assures on-time deliveries.

If your requirements are for beam control, color transmission or other uses of light, Kopp offers specialized knowledge based upon experience and research. If you wish to take advantage of the mechanical properties of glass—hardness, smoothness, corrosion resistance, wear resistance, etc.—we are in position to provide practical engineering design assistance.

KOPP GLASS, Inc.
Swissvale, Pennsylvania

KOPP GLASS

Revere Outdoor Lighting Report

Revere ELECTRIC MFG. CO.

Lighting a store front

The Problem: To draw attention to a store front and make it look inviting to shoppers by providing high level, uniform lighting for the wall and sidewalk area.

The Answer: Revere 9605 Fluorescent Luminaires were installed to give the high level of illumination desired. Eight-foot units were joined to form a continuous, attractive light source that makes the store look inviting. Each 8-foot unit contains two Very High Output lamps and has two 4-foot doors for fast, easy cleaning and maintenance.

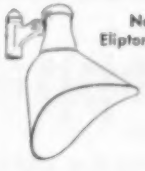
No. 9605
Fluorescent Luminaire

Lighting a race track

The Problem: To illuminate a race track for better visibility, and to provide especially high intensity lighting for dramatic effect at the finish line.

The Answer: Revere Eliptor Floodlights mounted on Revere Hinged Poles No. 199-D-30 were installed along the track. In the grandstand area, floodlights were aimed toward the finish line to heighten the intensity. Revere No. 2000 Series long range floodlights were mounted on the grandstand roof to further illuminate this area.

No. 2000 Series
Floodlight

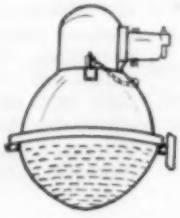


No. 3803
Eliptor Floodlight

Lighting a restricted area

The Problem: To illuminate a roadway encircling a restricted area at the Shippingport, Pa. Atomic Energy Generating Plant for both visibility and security.

The Answer: Revere Star-Lux Luminaires were installed around the entire perimeter of the restricted area, lighting the roadway and a 45° sloping embankment adjacent to it. Star-Lux Luminaires use up to 10,000 lumen incandescent lamps or 250 to 400-watt mercury lamps to provide any of the five A.S.A.-I.E.S. light distribution patterns.



No. 2311-A/2363
Star-Lux Luminaire

Write for Revere's complete catalog of outdoor lighting equipment

Revere ELECTRIC MFG. CO.

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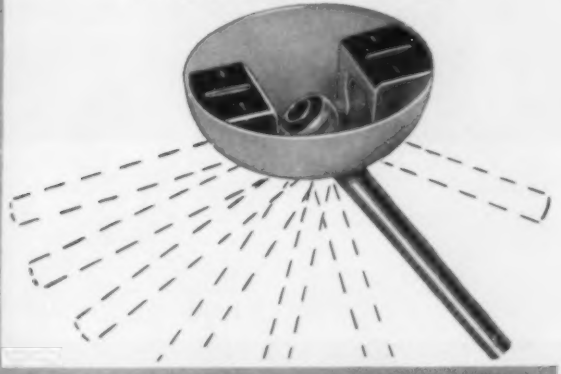

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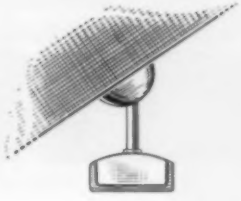
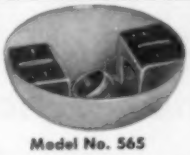


Model No. 575



Model No. 565

New Allegheny 45° Hang Straight Swivel Canopy available unfinished or with canopy electrostatically finished in white, yoke and ball cadmium plated. Choice of Model No. 575 with flash plate or Model No. 565 without flash plate.

Earthquake Approved by School Boards of California! New Allegheny Hang Straight 45° Swivel Canopy gives you a powerful "sales plus" in areas where flexible attachment of fluorescent ceiling fixtures is required. Gives you the perfect answer for the multitude of new slant ceiling installations in plants, schools, hospitals and institutions, too! See how it can help you increase sales and profits now! Write today!

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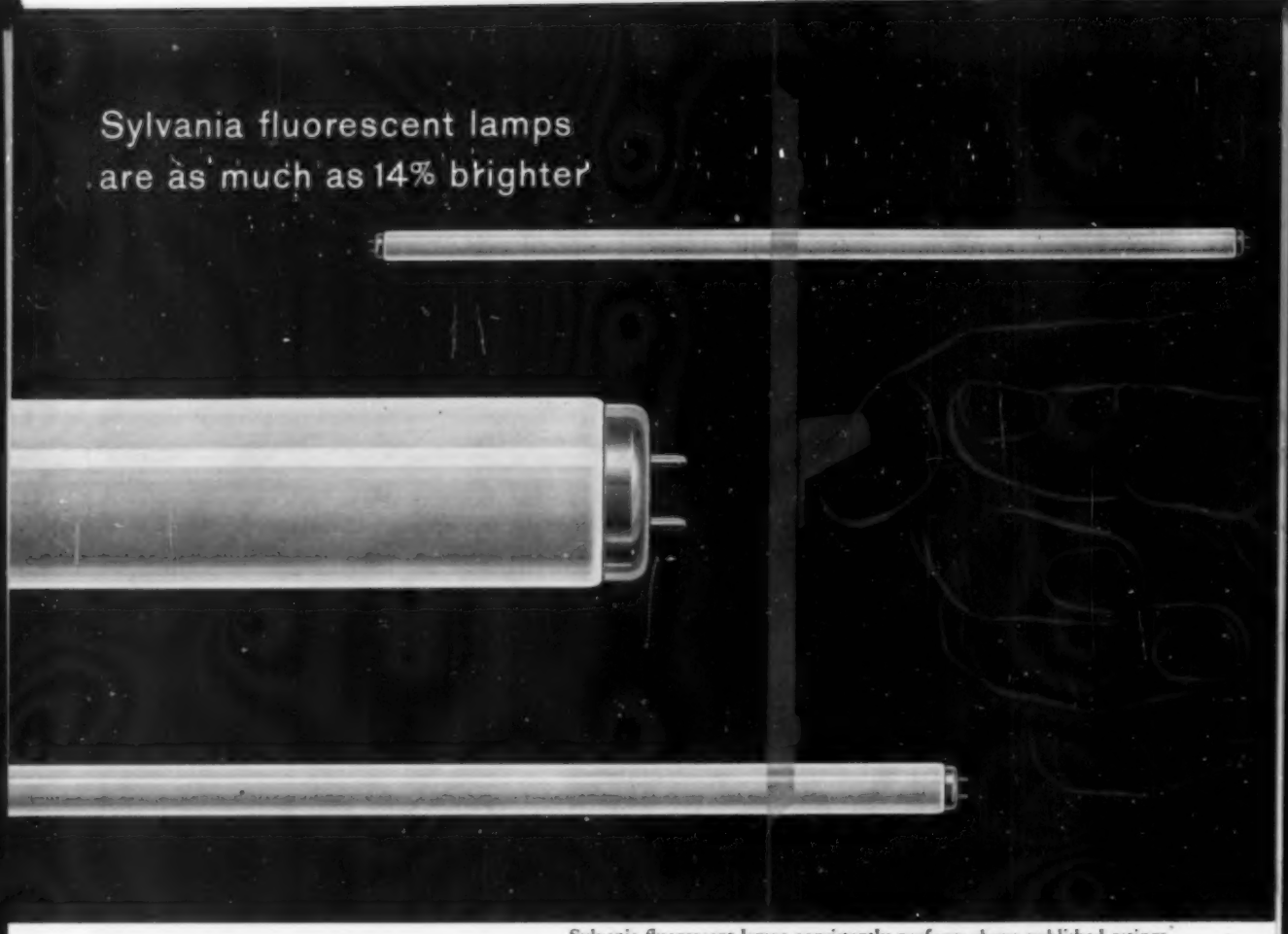

Sylvania fluorescent lamps consistently perform above published ratings from the start...deliver more light than other brands.

Another reason why

Sylvania Fluorescents give you more light at lower cost than all other brands

Advanced engineering makes Sylvania fluorescent lamps superior in many ways—makes light a better tool of production to increase profits

Tests in the laboratory and in working installations show that Sylvania fluorescent lamps consistently deliver more light.

During the past two years, alone, a comparison of Sylvania fluorescent lamp performance with the performance of other brands shows Sylvania lamps deliver as much as 14% more light.

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In Canada: Sylvania Electric (Canada) Ltd.
P. O. Box 1190, Station "O", Montreal 9.

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make light a better tool for profits

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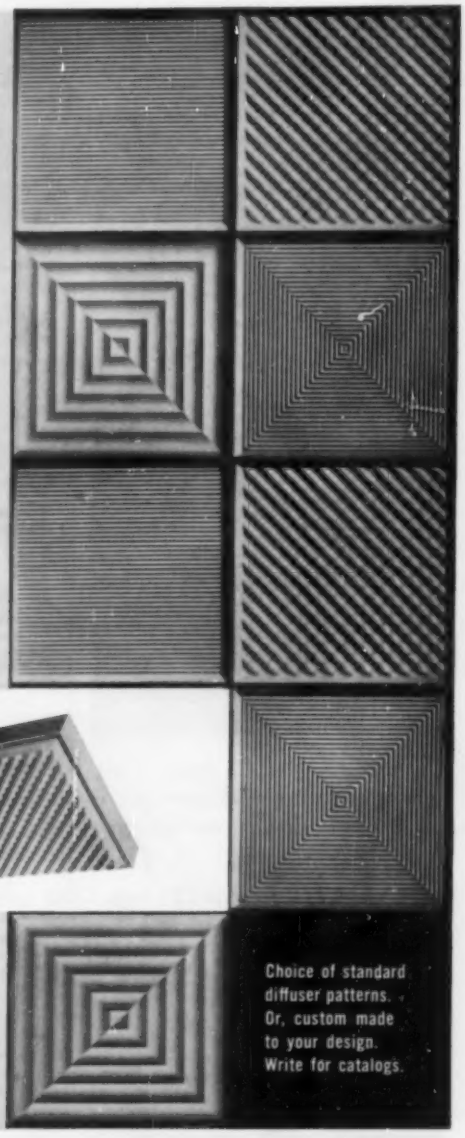

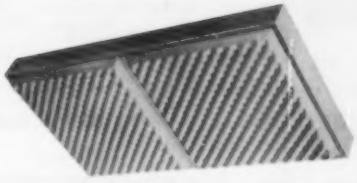

Choice of standard diffuser patterns. Or, custom made to your design. Write for catalogs.

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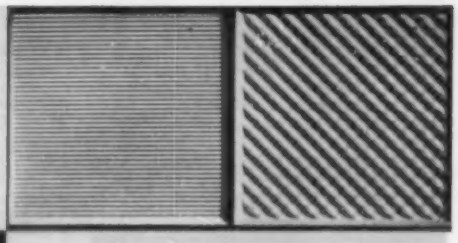

Engineers who specify AREA/LITER® stay with AREA/LITER®. Invented and perfected by All-Brite AREA/LITER® is America's most widely installed surface or recessed modular fluorescent fixture.

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PLANTS ALSO IN LOS ANGELES; PORTLAND, OREGON; AND VANCOUVER, B. C., CANADA.

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Cast Aluminum Quality

mcPhilben's 32-88 square ceiling unit is UL-approved for two 100 watt lamps. Its clean, modern lines, combined with maintenance-free operation, make it the ideal choice for institutions and industry: corridors, lobbies and lavatories.

The 32-88's face plate is of solid cast aluminum with a gleaming satin finish. Corrosion resisting construction features a reinforced and insulated back plate of zinc-clad bonderized steel. The cast carrara glass bowl swings to one side for easy cleaning. Available with mcPhilben's exclusive one-piece cast aluminum hinged guard. Also in vaportight 43-88 series.

Ask your nearby mcPhilben representative for full details. See our insert in Sweet's file 32a/mc or write for data sheet.

mc Philben
LIGHTING COMPANY
1329 Willoughby Avenue
Brooklyn 37, New York

(Continued from page 32A)

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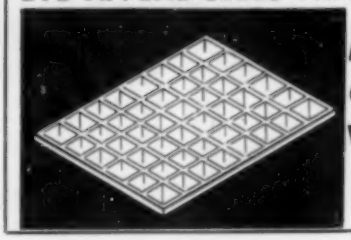

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(*Continued on page 53A*)

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Available in 2-lamp units 12" wide or 4-lamp units 24" wide. Actual depth only 3¼". Hinged plastic shield guaranteed not to warp or discolor.

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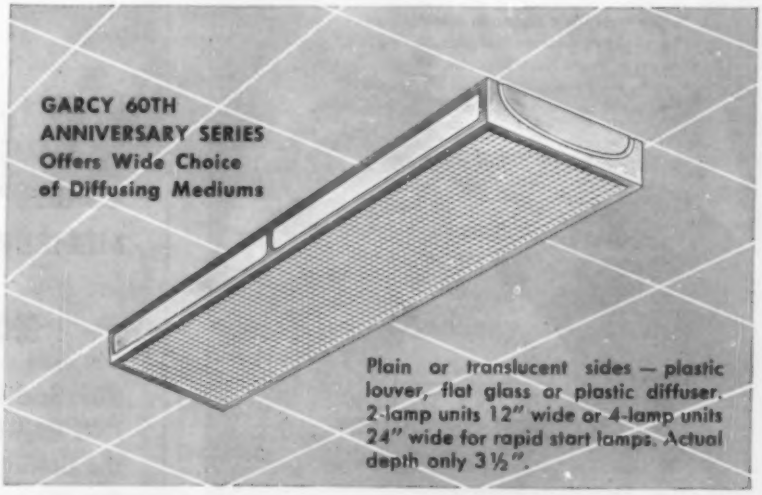
Take your choice of these two basic styles for shallow, surface-mounted lighting in either 12" or 24" width. Shallow construction makes them especially suitable for modern low-ceiling construction. Yet they offer all the benefits of deeper fixtures... fully hinged enclosures, uniform light distribution, and controlled surface brightness. Separable hinged enclosures simplify both installation and maintenance.

Send for Bulletins 581-L and 582-L.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makes a one man job of most all fixture hanging jobs.

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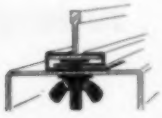

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(Continued from page 51A)

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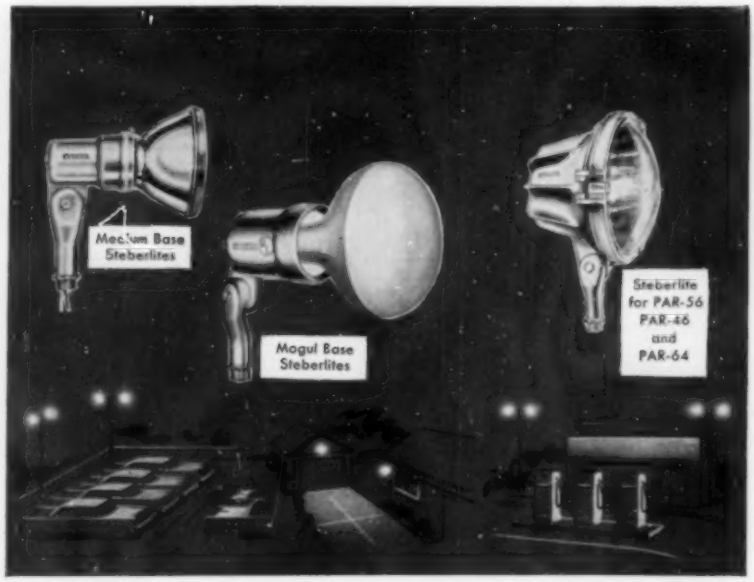

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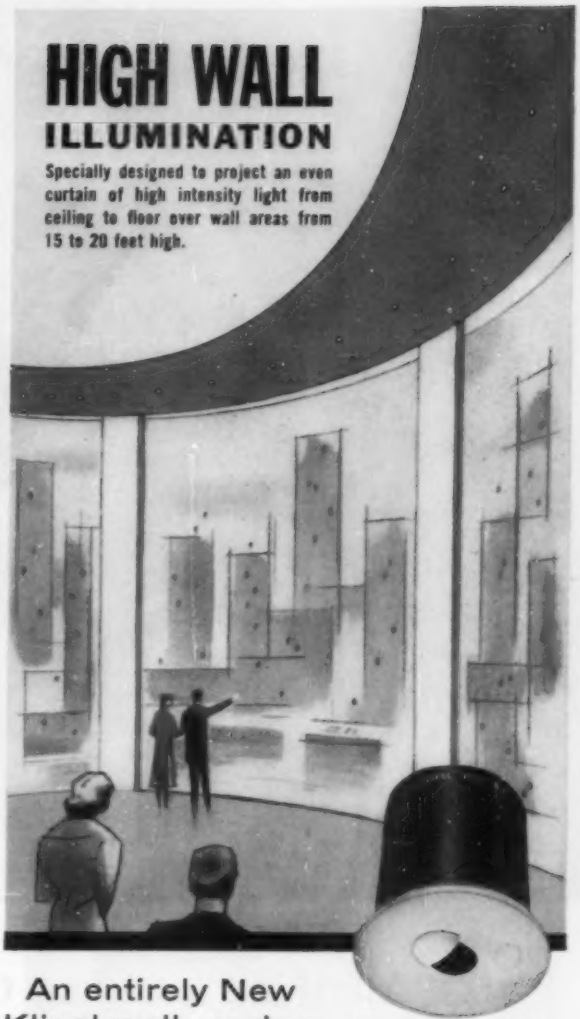

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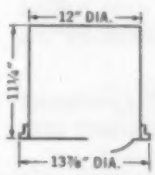

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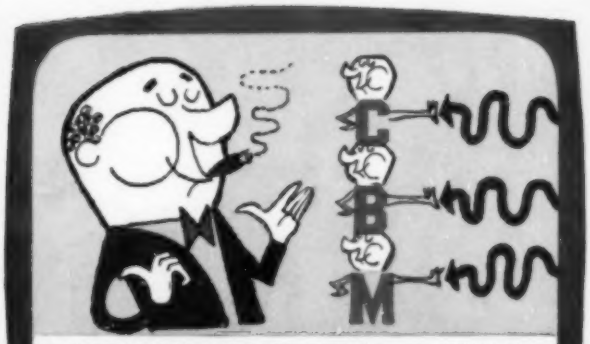

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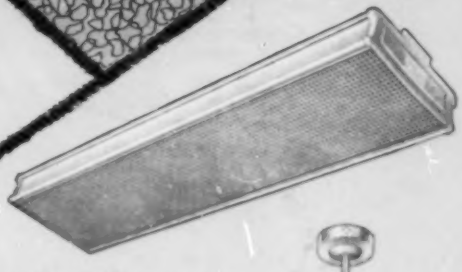

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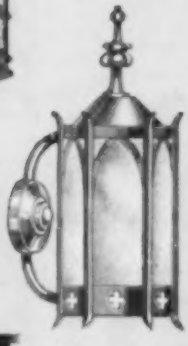

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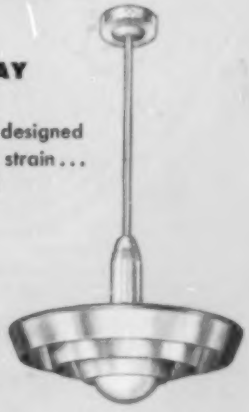

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